Exertional Leg Pain

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Disclosure

• No relevant financial relationships with commercial entities
Learning Objectives

• Discuss common etiologies of exertional leg pain

• Discuss best available evidence for the diagnosis and treatment of common causes of exertional leg pain

• Provide a practical algorithmic approach to the assessment and management of exertional leg pain
Exertional Leg Pain

• Common
• 10-15% of all runners
• 60% leg pain syndromes [Bates]

• Common Etiologies
  – Medial Tibial Stress Syndrome (MTSS)
  – Stress Fractures - Tibia
  – CECS (Chronic Exertional Compartment Syndrome)
  – PAES (Popliteal Artery Entrapment Syndrome)
  – Nerve Entrapments – Peroneal nerve

MTSS

- Overuse injury
- Diffuse pain along medial border of tibia
- Occurs with exercise REMITS with rest
- Stress reaction due to fascial traction at tibial attachment of soleus and deep crural fascia [Bouche]

MTSS

- Stress reaction at tibial attachment of soleus and deep crural fascia
MTSS

• True incidence unknown
• Most common cause of exertional leg pain in athletes
• 6-16% of all running injuries [Thacker]
• 5-15% of injuries in runners or military recruits [Thacker]

MTSS Risk Factors

- Prev Hx of MTSS or stress fx
- Running < 5 yrs
- Need for orthotics [Hubbard]
- Female
- Excessive pronation [Moen]
- Calf tightness/weakness

Hubbard, MSSE 2009; 41(3): 490-496.
MTSS

- Plain films: Normal
- Triple phase bone scans: Diffuse longitudinal uptake along the tibial periosteum
MTSS

- MRI has some utility in distinguishing MTSS from Stress Fx
MTSS - Treatment

• Acute
  – Ice and Rest [Beck]
  – Modalities – u/s, phonophoresis, e-stim

• Sub Acute

• Modify training
  – Decrease training by 50%, avoid hills and uneven surfaces
  – Cross training

• Appropriate footwear

• Orthotics (individuals with biomechanical problems)

• Correction of Intrinsic factors

MTSS

• Other Potential Treatments
• Low Energy ESWT may be effective [Rompe]
• Accupuncture [Callison]
• Refractory cases may require deep posterior fasciotomy (success rate 60-90%)

• Prevention – correction of intrinsic/extrinsic factors
• Systematic Review (199 articles reviewed, 4 compared interventions)
• Only intervention that worked was shock absorbing insoles [Craig]

Tibial Stress Fracture

- Stress Fx
- 5-12% of all sports injuries [Matheson]
- 40-49% of athletes that get stress fx will be in tibia [Armstrong]
- F>M

Tibial Stress Fx – Risk Factors

• Risk factors:
  – Previous stress fx
  – Female
  – Younger age
  – Low bone mineral density
  – Menstrual irregularity
  – Poor nutritional status
  – Biomechanical abnormalities (pes cavus/inc hip ext rot)
Tibial Stress Fx – Risk Factors

• Increased running speed = increased bone loading
  – 2.5-3.5 inc 10%
  – 3.5-4.5 inc 7% [Edwards]

• Stride Length
  – 10% reduction decreased prob stress fx 6% [Edwards]

Tibial Stress Fx

• Most common site of stress fracture (50% of all stress fx)
• 5-12% military recruits [Armstrong]
• F>M approx 57% of stress fx occur in F [Taunton]
• Majority occur posteromedial aspect of the middle third of the shaft

Tibial Stress Fx - Symptoms

- Insidious onset of leg pain
- Initially only with exertion – eventually at rest
- Focal location of pain
Tibial Stress Fx

- Radiographs – initially negative
- May be pos if sx > 2-3 weeks
- Triple phase bone scan + in all three phases
- Focal uptake
- MRI – highly sensitive and specific for stress fx [Gaeta]
### Table 1
Low-risk stress fracture treatment guide

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Goal</th>
<th>Treatment suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any level of pain</td>
<td>Heal injury</td>
<td>Titrature activity to a pain-free level for 4-8 w depending on the grade of injury</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Braces/crutches</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Modify risk factors</td>
</tr>
<tr>
<td>Pain with no functional limitations</td>
<td>Continue participation</td>
<td>Titrature activity to a stable or decreasing level of pain</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Closely follow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Modify risk factors</td>
</tr>
<tr>
<td>Pain with functional limitation</td>
<td>Continue participation</td>
<td>Decrease activity level to point at which pain level is decreasing and until a functional level of pain has been achieved, then titrate activity to stable or continued decrease level of pain</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Modify risk factors</td>
</tr>
<tr>
<td>Limiting pain intensifies despite functional activity modification (ie, unable to continue to perform at any reasonable functional level despite activity modification)</td>
<td>Heal injury</td>
<td>Complete rest</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Immobilization</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Surgery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Modify risk factors</td>
</tr>
</tbody>
</table>

Tibial Stress Fx - Treatment

• Pneumatic leg braces reduce healing time [Swenson]

• Capacitively coupled electric field (bone) stimulation may be indicated for severe injury or elite athletes [Beck]

• Low-level mechanical vibrations may be effective [Wood]

Wood, Meyering – research in progress
Tibial Stress Fractures

• Athletes with multiple stress fractures or who have delayed healing should have a DEXA scan
• Those with nutritional deficits should take calcium (1500mg/d) along with Vit D
• Vitamin D deficiency has been shown to be a factor in non-union [van Demark]
• Animal studies suggest that NSAIDS may decrease healing of stress fx [Wheeler]
• All high risk tibial stress fractures (dreaded black line) and non-unions or delayed healing (>6 mo) should be referred for orthopedic consultation

CECS

• Well defined and REPRODUCIBLE point in the run and increases if training persists.
• Same distance and intensity each time
CECS

- Reversible ischemia secondary to non-compliant fascial compartment
- 4 compartments
  - Ant (45%)
  - Lat (40%)
  - Deep post (10%)
  - Superficial post (5%)
Anatomy

Cross section just above middle of leg

- Tibialis anterior m.
- Extensor hallucis longus m.
- Extensor digitorum longus m.
- Superficial peroneal n.
- Tibia
- Interosseous membrane
- Greater saphenous v. and saphenous n.
- Tibialis posterior m.
- Flexor digitorum longus m.
- Peroneal a. and vv.
- Posterior tibial a. and vv. and tibial n.
- Flexor hallucis longus m.
- Crural fascia
- Plantaris tendon
- Gastrocnemius m. (medial head)
- Medial sural cutaneous n.
- Lesser saphenous v.
- Peroneal communicating branch of lateral sural cutaneous n.
- Soleus m.
- Lateral sural cutaneous n.
- Transverse intermuscular septum
- Posterior intermuscular septum
- Anterior intermuscular septum
- Peroneus longus m.
- Peroneus brevis m.

5th compartment

FDL – Fibular Origin
CECS

• Anterior Compartment:
  – Weakness of dorsiflexion or toe extension and paresthesias over dorsum of foot

• Lateral Compartment:
  – Sensory changes over anterolateral aspect of leg and weakness with ankle eversion

• Deep Posterior:
  – Paresthesias plantar aspect of foot, weakness of toe flexion and ankle inversion

• Superficial Posterior:
  – Sensory changes dorsolateral foot, plantar flexion weakness
CECS

• If CECS is suspected, must examine after exercise that initiates the symptoms

• Neurovascular status should be documented
CECS

- Hallmark diagnostic tool is compartment testing
CECS

- CPT should be performed at REST and after REPRODUCTION of symptoms
- 1 and 5 minutes post exercise
- Confirmatory
  - > 15mm Hg at rest
  - >30 mm Hg 1 min post
  - >20 mm Hg 5 min post

[Pedowitz]

- Should check with local orthopedists to find local standard

CECS

• Triple Phase Bone Scan
  – Decreased radionuclide in area of increased pressure during uptake phase

• MRI
  – Evolving and promising tool
  – Detects fascial thickening, fatty infiltration, decreased T1 signal with fibrosis, and muscle atrophy [van den Brand]

CECS

• Conservative Treatment
• Massage may be effective for ant comp synd [Blackmail]
• May be satisfactory for those willing to decrease activity

• Surgery (Fasciotomy)
• Symptoms > 3 months
• High level athletes

• Early weight bearing as tolerated following surgery improves outcomes [Fraiport][Kaeding]

PAES

• Abnormal course of the popliteal artery within the popliteal fossa

• Congenital abnormality

• Deep ache are cramping involving foot or leg with high intensity running activity
PAES

- Predominantly
- Males < 30
- High intensity exercise
- Excessive dorsiflexion/plantar flexion

- Classically unilateral, but some studies report up to 80% cases may be bilateral [Levien]

PAES

• Examine bilateral pulses
• Reexamine with dorsiflexion and plantarflexion with knee in extension (places tension on the gastroc leading to compression of the pop art.)
• Dynamic changes in pulses = high suspicion for PAES

• MRI/MRA screening tool – decreased flow with provocation
• Arteriography should be performed after exercise (or in positions of provocation) [Baltopoulous]

• Dynamic MRI in the future?

• Preferred MGMT = surgery

Dynamic Nerve Entrapment

• Running motion produces complex, forceful, repetitive, lower limb movements that can compress, stretch or dislocate nerves as they travel through compartments and tunnels.

• Numbness or tingling or pain brought on by activity

• Common peroneal nerve is the most commonly injured lower extremity nerve

• Superficial location lateral to surgical neck of the fibula
Dynamic Nerve Entrapment

- Common peroneal n.
  - Lateral leg/foot

- Sup. Peroneal n
  - Lateral calf/dorsum foot
Dynamic Nerve Entrapment

- TTP at area of nerve compression
- Compression/percussion yields paresthesia = principle sign
- Comm Peroneal – Fibular neck – radiates distally
- Sup Peroneal – 7-12cm above lateral malleolus
Dynamic Nerve Entrapment

• EMG
  – conducted before and after exercise.

• Diagnostic nerve block

• Inject area:
  – Tinel’s sign strongest
  – Maximum tenderness
  – ? U/S guided

• MRI
  – May be helpful [Moore]
  – Neurogenic edema

Dynamic Nerve Entrapment

- Conservative management:
  - Activity modification, massage, iontophoresis

- Surgery may be needed if no improvement after 3-4 months
Summary

• Exertional leg pain is common
• MTSS most common etiology
• MTSS and Tibial Stress Fx exist on continuum

• Diffuse tibial pain with activity = MTSS
• Focal tibial pain at rest = Stress Fx
• Reproducible pain at same distance/intensity = CECS
• Pain with certain distance and abnormal pulses = PAES
• Pain with numbness/tingling or neurodist = DNE
Algorithms: Exertional leg pain
History and Physical Algorithm

History of Exertional Pain PLUS Pain at Rest/Palpable tenderness

- Yes
  - >1-2cm of palpable tenderness
    - MTSS
    - Stress Fx

- No
  - No rest pain, POS palpable tenderness
    - Paresthesia with activity?
      - Yes
        - Possible Nerve Entrapment
          - Normal pedal pulse with provocation
            - Yes
              - CECS
            - No
              - PAES
        - No
      - No rest pain, NEG palpable tenderness
Diagnostic Studies Algorithm

MTSS
Stress Fx
CECS
PAES

Neg → Plain Radiographs

Pos → 2-3 weeks of symptoms

Neg → Bone Scan

Pos → Focal

Neg → Linear

MTSS

Focal → Stress Fracture

Linear → MTSS

Stress Fracture

Ambiguous Presentation?

Yes → MRI

Neg → Consider Dynamic Arteriogram

Pos → PAES

No → Classic Presentation for CECS?

Yes → Compartment Pressure Testing

Neg → Diagnosis

Pos → CECS

MTSS, Stress Fx, Bone Contusion, Soft Tissue Injury

Possible Nerve Entrapment
Questions