Exertional Lower Leg Pain in the Young Athlete

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Occurrence / Incidence

- 35 M children and teens in organized sports in U.S.
- Increase in acute and overuse injuries
- 45-60% involve the lower extremity
- Potential for long term sequelae
Contributing Factors

- Participation at younger age
- Increased intensity and competition
- Single-sport, year-round play
- Participation during peak growth years
- Psychological stressors: parents, coaches, trainers
Etiology of Overuse Injuries

- Repeated mechanical loading exceeds remodeling capability
- Growth centers and periarticular structures incur microtrauma
- Loss of collagen continuity, increased vascularity, mast cells, fibroblasts
Intrinsic and Extrinsic Factors

- Intrinsic Factors
  - skeletal immaturity
  - adolescent growth spurt
  - anatomic variations and biomechanics
  - coordination / conditioning
  - psychological maturity
  - gender

- Extrinsic Factors
  - training intensity and volume
  - training environment
  - equipment
Injury Patterns

- Stress Related
- Physeal / Apophyseal
- Neurovascular
- Tendinopathies
Medial Tibial Stress Syndrome

- “Shin splints”- Insidious onset of distal, medial tibial pain relieved with rest
- Most common overuse injury in runners (19%) overtraining main cause
- Represents a soleus fasciitis, tibial periostitis
- PE:TTP postero-medial cortex; biomechanical factors: pes planus/cavus, pronation
- X-Rays negative. Bone scan or MRI may be necessary to distinguish stress fracture
MTSS
Adductor Insertion Avulsion Syndrome

Painful condition affecting the mid to proximal thigh at the adductor group insertion

Seen in cross country and distance runners. Similar to MTSS thus nicknamed “thigh splints“
Stress Fractures

- Ultimate overuse injury
- Bone resorption exceeds formation
- Majority affect lower extremities
- Some associated morbidity
Stress Fractures: lower leg

- Tibia most common bone affected (34%); occur at junctional regions
- Insidious then persistent and limits activity
- PE: localized, exquisite TTP, palpable bump, (+) hop test
- X-rays: negative > 50%, periosteal elevation, sclerosis a late finding
- Bone scan extremely sensitive within 3 days; MRI demonstrates edema, possible fracture line
16 y/o distance runner
Stress Fx. Anterior Tibial Cortex

- “Tension” stress fracture.
  involves anterior 1/3

- Variable course and prognosis

- X-ray reveals horizontal radiolucency – DBL

- May require surgery
Stress Fractures: Femur

- Femoral neck: insidious then persistent anterior hip or groin pain
- PE: painful passive IR, (+) hop test
- MRI diagnostic; determines compression vs. tension type which effects treatment.
- Compression (medial): NWB x 8wks.
  - Tension (lateral): ORIF
- Have a high index of suspicion-don’t miss !!!
17 y/o female runner with groin pain
Femoral Shaft (Diaphyseal) Stress Fracture

- Insidious then persistent mid-thigh pain
- Feels like quad strain
- PE: TTP mid to proximal decreased heel to butt; (+) fulcrum, (+) Hop
- Bone scan or MRI
Metatarsal Stress Fractures

- 1855 “march fx” Prussian military physician
- Dorsal forefoot pain
- Rest, bootwalker, carbon insert
Jones Fracture

- Pain, tenderness, swelling base of 5th MT
- Diaphyseal fx with non-union potential
- Cast, NWB vs ORIF
Navicular Stress Fracture

- Medial midfoot pain
- Be suspicious
- MRI/CT
- Crutches, NWB x 8wks
- Non-union possible
Navicular Osteochondrosis

- Kohlers dz.-medial midfoot pain
- X-ray: wafer shaped navicula
- Delayed ossification vs AVN
- Normal as adult
Freiburgs Infraction

- Osteochondrosis of 2nd MT head
- Adolescent athletes in high impact sports develop progressive pain in forefoot, swelling, limp
- Exam: TTP, decreased motion; X-ray diagnostic
- Tx: early stages conservative later stages Sx.
Apophyseal injuries

- Occur at immature tendon-bone attachments effected by long bone growth and movement
- Relative weakness of growth cartilage relative to tendon induces traction effect on apophysis
- Localized pain, swelling, tenderness
- Widening or fragmentation occurs
- Tibial tubercle apophysitis (Osgood-Schlatter)
- Calcaneal Apophysitis (Sever’s)
Osgood-Schlatter Disease

- Tibial tubercle apophysitis produced by traction of quadricep mechanism
- Pain, swelling, tenderness of tibial tubercle; 11-15 yrs; M>F; uni or bilateral
- Loss of heel to butt ROM
- Pain with resisted extension
- Rest, ice, quad stretches, patellar strap
Osgood-Schlatter
Sinding-Larsen–Johansson
Sever’s Disease

- Calcaneal apophysitis caused by traction of the gastroc-soleous complex
- 9-12 yrs; impact sports; M>F
- Pain, compression tenderness, tight heelcords
- Rest, ice, Achilles stretching, visco-heels
Severs’ Disease
Apophyseal Injuries: Hip/Pelvis

- Multiple sites around hip and pelvis vulnerable to repetitive forceful contraction of muscles
- Occur between 10 yrs. - late teens
- Focal pain, localized TTP and swelling
- Hx. may involve “pop” during explosive action
- X-ray reveals widening or avulsion
## Apophyseal Injuries: Hip/Pelvis

<table>
<thead>
<tr>
<th>Site</th>
<th>Attachments</th>
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<tbody>
<tr>
<td>Iliac crest</td>
<td>Ext. obliques</td>
</tr>
<tr>
<td>ASIS</td>
<td>Sartorius</td>
</tr>
<tr>
<td>AIIS</td>
<td>Rectus femoris</td>
</tr>
<tr>
<td>G. Troch</td>
<td>Gluteus medius</td>
</tr>
<tr>
<td>L. Troch</td>
<td>Iliopsoas</td>
</tr>
<tr>
<td>Pubic symph</td>
<td>Adductors</td>
</tr>
<tr>
<td>Ischial tub.</td>
<td>Hamstrings</td>
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</tbody>
</table>
Avulsion: Iliac crest and Lesser Trochanter
Avulsion: ASIS and AIIS

**Figure 1.** Fracture of the anterior inferior iliac spine in a 13-year-old boy.
Avulsion: Ischial Tuberosity
Neurovascular Causes

- Exertional Compartment Syndrome
- Meralgia Paresthetica
- Popliteal Artery Entrapment Syndrome
- Posterior Tibial Nerve Entrapment (Tarsal Tunnel Syndrome)
Exertional Compartment Syndrome

- Increased pressure in fascial compartments leads to recurrent pain with exercise
- S/S occur at predictable duration or intensity
- Pain: cramping, burning, squeezing
- PE (rest): fascial defect, muscle hernia
  PE (post-exercise): tense, firm compartment, TTP and passive stretch; foot drop, paresthesias
Exertional Compartment Syndrome

Dx consists of confirmed elevated compartment pressure coinciding with reproduction of Signs and symptoms

Treatment typically involves compartment fasciotomy
Meralgia Paresthetica

The lateral femoral cutaneous nerve enters the thigh under the inguinal ligament near the anterior superior iliac spine and is subject to trauma or compression.

Pain and dysthesias of the anterolateral thigh. Positive Tinel’s medial to the ASIS.
Ischemic or claudicant calf pain exacerbated by exercise.

Anatomic variations include accessory medial head of the gastrocnemius or altered course of the popliteal artery. Occlusive or aneurysmal changes can occur.

Dx by arteriography or MRA.
Tx by surgical exploration.
Posterior Tibial Nerve Entrapment

*Tarsal Tunnel Syndrome* refers to various sites of entrapment of the nerve or its branches. Most occur distal to the ankle.

*Joggers foot* has been described in runners with pes planovalgus, hyperpronated foot.

Burning, tingling, numbness  
Medial ankle, plantar aspect of foot
Tendinopathies

- Iliotibial Band Syndrome
- Snapping hip
- Patellofemoral Pain Syndrome
- Achilles tendinitis
- Plantar fasciitis
ITBand Syndrome

- The iliotibial band lies anterior to the lateral femoral condyle when the knee is in extension and passes posterior to it with flexion.

- The coursing back and forth over this bony prominence is the cause of a symptom complex referred to as the *iliotibial band (friction) syndrome*.

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Snapping Hip

External snapping hip syndrome: the iliotibial band courses over the greater trochanter.

Internal snapping hip syndrome: the iliopsoas tendon snaps over the iliopectineal eminence of the pelvic brim as it proceeds to its insertion on the lesser tuberosity.
Patellofemoral Pain Syndrome

- Frequent complaint among adolescent girls
- Insidious onset of anterior knee pain
- Multifactorial: repetitive loading of the PFJ
  - Biomechanical factors: tight hams, quads
  - Anatomic factors: wide pelvis, genuvalgus recurvatum, pes planus
  - Malalignment causes lateral patellar tracking
- Chondral, periarticular irritation/inflammation
Malicious Malalignment
Achilles Tendinitis

- Retrocalcaneal pain 2-4 cm proximal to attachment (watershed zone)

- Most common in dancers, soccer and basketball players

- Pes planus or cavus

- Consider Sever’s dz., retrocalcaneal bursitis

- Rupture uncommon in young athlete
Heel Pain

Inflammation of Achilles Tendon

Achilles tendon

Calcaneus (heel bone)

Retrocalcaneal bursa

Insertion of Achilles tendon

Subcutaneous calcaneal bursa
Treatment

- Protect injury by reducing volume and intensity of exercise
- Perform corrective exercise and rehab
- Identify and correct biomechanical and anatomic deficiencies
- Identify and correct training errors
- Gradual return to full activities
Prevention

- Pre-participation examination
- Education / Supervision – parents, coaches regarding risks and signs of injury
- Inspect / Repair equipment and playing fields
- Avoid training errors
- Consider delay of sport specialization
Plantar Fasciitis

Palpation of the medial tubercle of the calcaneus reproduces the pain of plantar fasciitis.
Clinical Pearl

- Osteoid osteoma is a benign osteoblastic tumor which classically produces night pain that can be relieved by nonsteroidal anti-inflammatory drugs. On physical examination, there usually is tenderness over the lesion.

- Surgical incision or radiofrequency ablation of the nidus is curative and may be done using computed tomography imaging and minimally invasive technique. The prognosis is excellent, with no known cases of malignant transformation, although the lesion has a tendency to recur.
References

- Gaeta M et al. Diagnostic Imaging in Athletes with Chronic Lower Leg Pain. AJR 2008;191:1412-1419
- Boutin R D et al. MR Imaging Features of Osteochondritis Dissecans of the Femoral Sulcus. AJR 2003;180:641-645
References


- Bryant L R et al. AJR 2008;191:1010-1015
- Hwang B et al. AJR 2005;185:166-173
- Zukotynski K et al. AJR 2010;195:1212-1219
- Major N M AJR 2006;186:255-258
- Thapa M M et al. AJR 2012;198:W456-W465
- Zhong H et al. AJR 2011;197:W1147-W1154
- Anderson M W et al. AJR 2001;177:673-675
- Schweitzer M E, Karasick D AJR 2000;175:627-635
- Balen P F, Helms C A AJR 2001;176:1137-1143
Stress Fractures in U.S. Navy Sea, Air and Land trainees


Right: AP radiograph of the proximal femur in a 19-year-old U.S. Navy S.E.A.L. trainee shows a complete displaced femoral neck fatigue fracture.
Male long-distance runner who presented with right leg pain.
Deutschländer's disease, the first report of a stress fracture is credited to Breithaupt, a Prussian military physician, who described it in 1855.

He described foot pain and swelling in new military recruits, and the metatarsal fractures he observed are now commonly called march fractures.
Apophysitis

Apophyses are the sites of attachment of tendons at long bones. They are the site of origin or insertion of major muscles or a muscle group.

<table>
<thead>
<tr>
<th>Specific Apophyseal Avulsion Injuries—Cont’d</th>
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<tbody>
<tr>
<td><strong>Site</strong></td>
</tr>
<tr>
<td>Lesser trochanter</td>
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<td></td>
</tr>
<tr>
<td>Greater trochanter</td>
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<tr>
<td></td>
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<tr>
<td>Pubic symphysis</td>
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</table>
Physeal Injury – Slipped Capital Femoral Epiphysis

- SCFE: Salter-Harris type 1 Fracture of proximal femoral physis – 20% bilateral
- more common in overweight, adolescent males, and often presents as insidious thigh/knee pain
- Melting ice cream on a cone radiographic appearance
- Emergent orthopedic surgery to prevent avascular necrosis of femoral head
Klein’s Line

Klein’s line

A line tangential to superior aspect of femoral neck on AP radiograph should intersect the epiphysis in a normal hip. It was originally described for use on the AP radiograph but can also be used on the lateral view.
Legg-Calve-Perthes Disease

- An idiopathic avascular osteonecrosis of the capital femoral epiphysis of the femoral head—found in young children and cause early osteoarthritis
- Decreased hip ROM, antalgic gait in a young child
- May present as isolated knee pain, limp
Exertional Compartment Syndrome

- **Peroneal compartment**
  - Peroneus longus
  - Peroneus brevis
  - Superficial peroneal nerve

- **Anterior compartment**
  - Tibialis anterior
  - Extensor digitorum longus
  - Extensor hallucis longus
  - Peroneus tertius
  - Anterior tibial artery/veins
  - Deep peroneal nerve

- **Deep posterior compartment**
  - Tibialis posterior
  - Flexor digitorum longus
  - Flexor hallucis longus
  - Popliteus
  - Posterior tibial artery/veins
  - Peroneal artery/veins
  - Tibial nerve

- **Fibula**
- **Tibia**

**Superficial posterior compartment**
- Soleus
- Gastrocnemius
- Plantaris tendon
19-year-old man with popliteal vascular entrapment syndrome who presented appeared with hard exercise and abated with rest.

Left: Volume-rendered image in posterior projection shows both popliteal arteries (white arrows) separated from popliteal veins (black arrows) by medial head of gastrocnemius muscles (asterisks). Origin and course of medial head of bilateral gastrocnemius muscles are evident.

Right: Occlusion of right popliteal artery is seen on 64-MDCT angiography image.
Chronic compartment syndrome in long distance runners

Left: Chronic compartment syndrome in 30-year-old man who was runner. Fat-saturated T2-weighted axial MR image, obtained immediately after exercise, shows evident edema of tibial anterior and deep posterior compartment muscles (arrows). Slight, questionable hyperintensity can be seen in other muscles of anterior compartment (arrowheads).

Right: 33-year-old female long-distance runner with right lower leg chronic exertional compartment syndrome lasting 3 months. Fat-suppressed T2-weighted axial MR image obtained immediately after pain-inducing exercise shows swelling and hyperintensity of anterior compartment muscles.
Adductor Insertion Avulsion Syndrome (Thigh Splints):
19-year-old female lacrosse player with right thigh pain.
Chronic hypertrophic demyelinating neuropathy of the common peroneal nerve
Medial patellofemoral ligaments
Medial Tibial Stress Syndrome