

# Exertional Lower Leg Pain in the Young Athlete

Paul S. Saenz D.O., FAOASM  
OMED 2012, San Diego

# 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



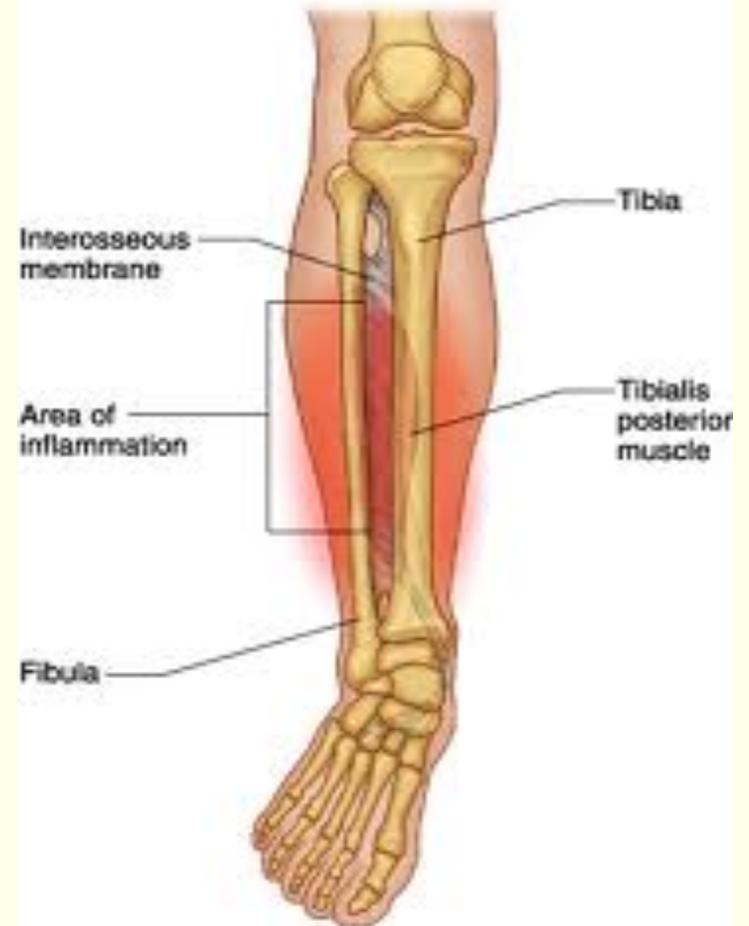
# Medial Tibial Stress Syndrome

- “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



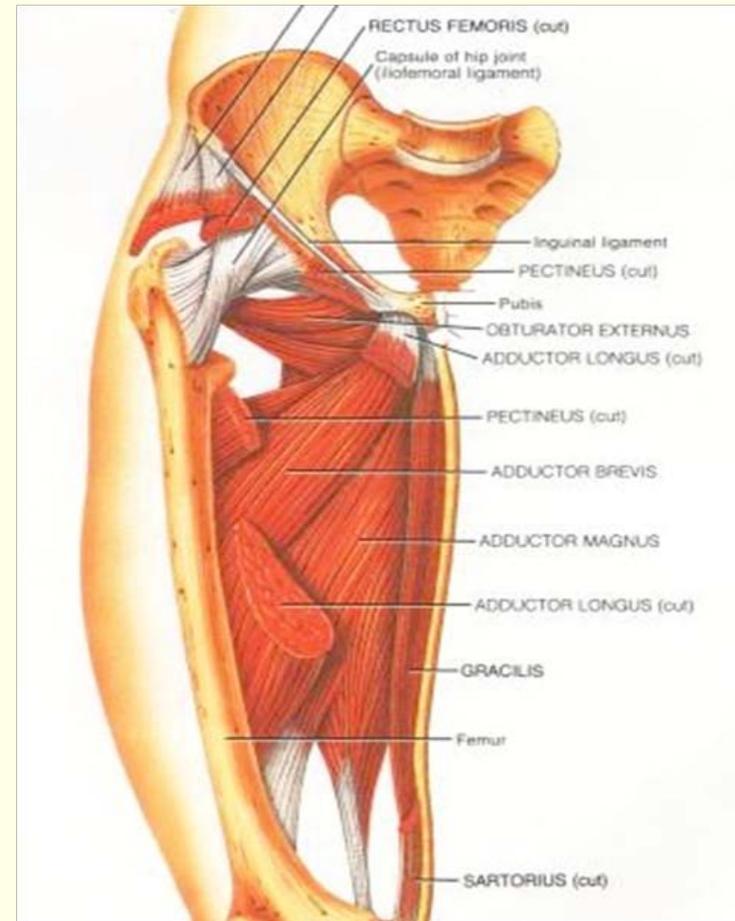
© sportsmedinfo.net medical art



# Adductor Insertion Avulsion Syndrome

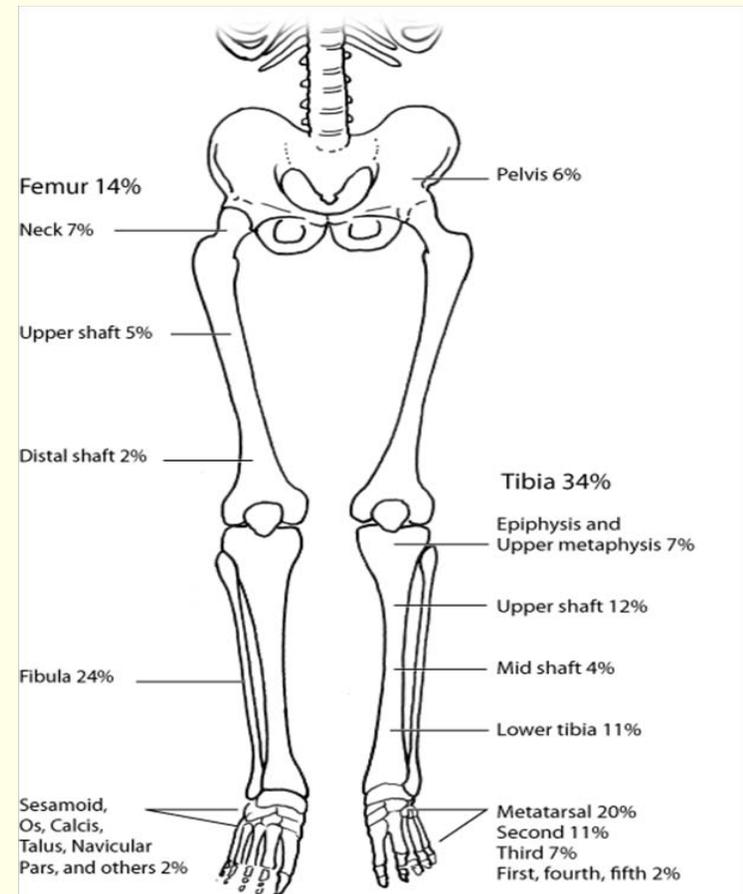
**Painful condition affecting the mid to proximal thigh at the adductor group insertion**

**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

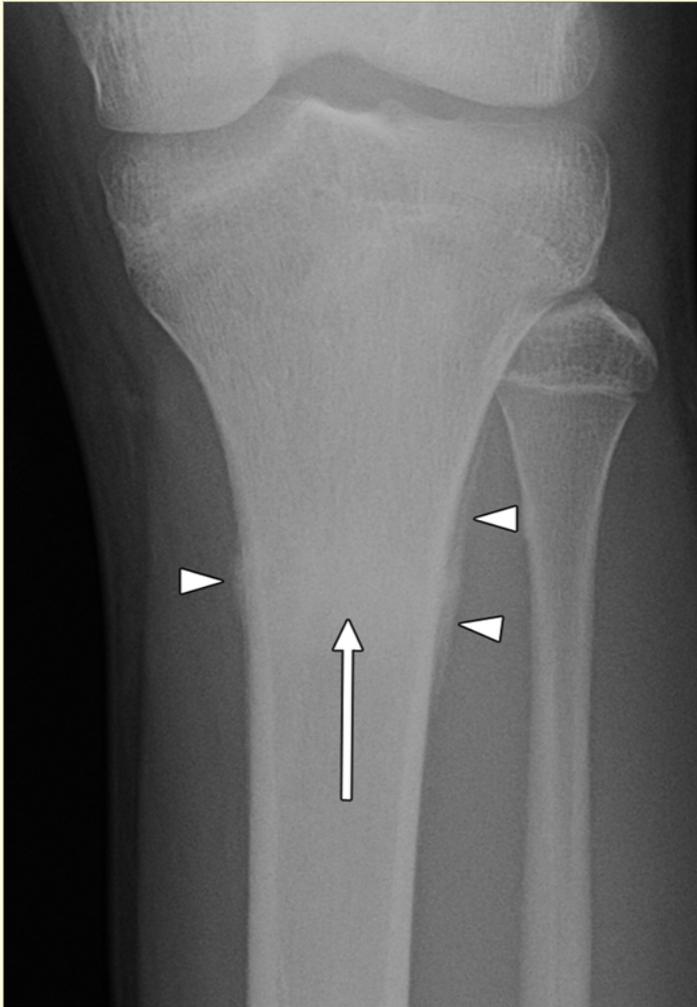


Source: John Imboden, David B. Hellmann, and John H. Stone: *Current Rheumatology Diagnosis & Treatment*, Second Edition: <http://www.accessmedicine.com>  
Copyright © The McGraw-Hill Companies, Inc. All rights reserved.

# 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

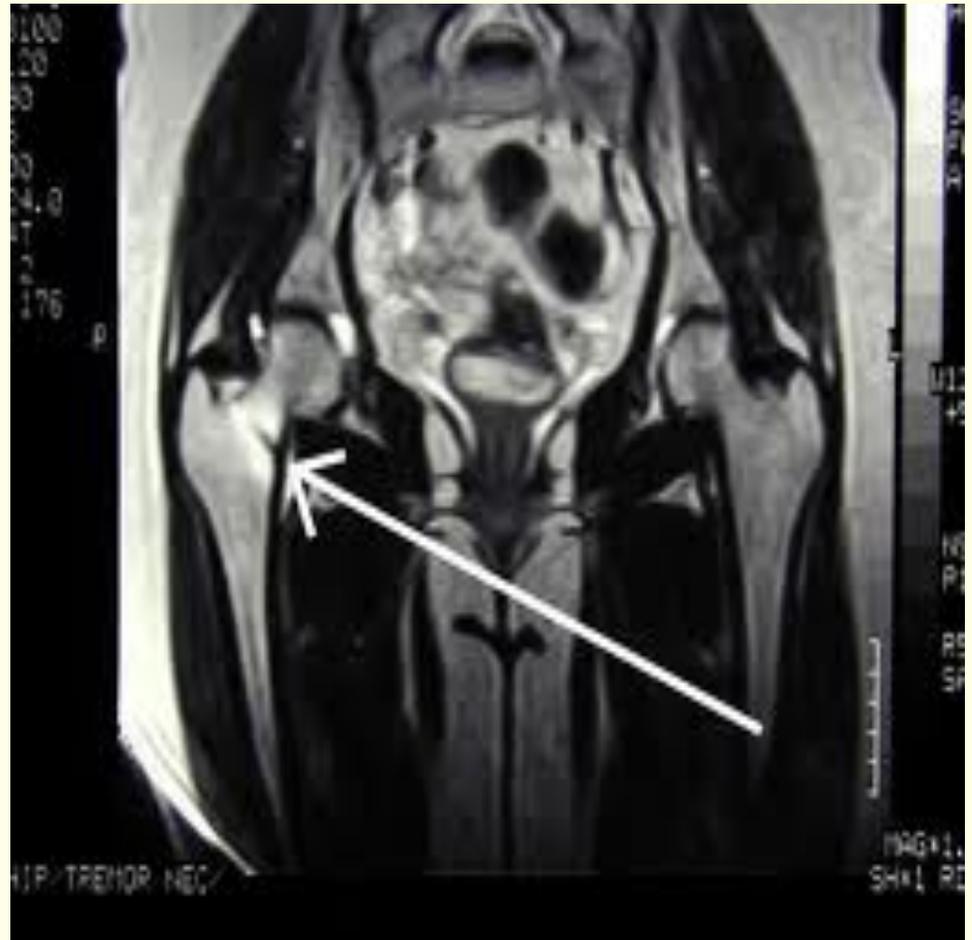


Source: South-Paul JE, Matheny SC, Lewis EL: *CURRENT Diagnosis & Treatment in Family Medicine, 3rd Edition*: www.accessmedicine.com  
Copyright © The McGraw-Hill Companies, Inc. All rights reserved.

# Stress Fractures: Femur

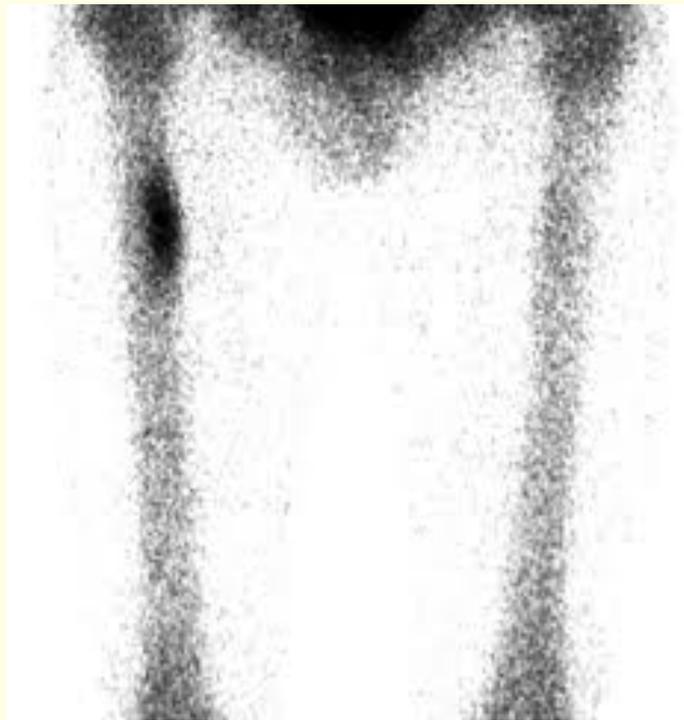
- Femoral neck: insidious then persistent anterior hip or groin pain
- PE: painful passive IR, (+) hop test
- MRI diagnostic; determines compression vs. tension type which effects treatment.
- Compression (medial): NWB x 8wks.  
Tension (lateral): ORIF
- Have a high index of suspicion-don't miss !!!

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 5<sup>th</sup> 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 Infracion

- **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
- Realtive 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 quadriceps 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

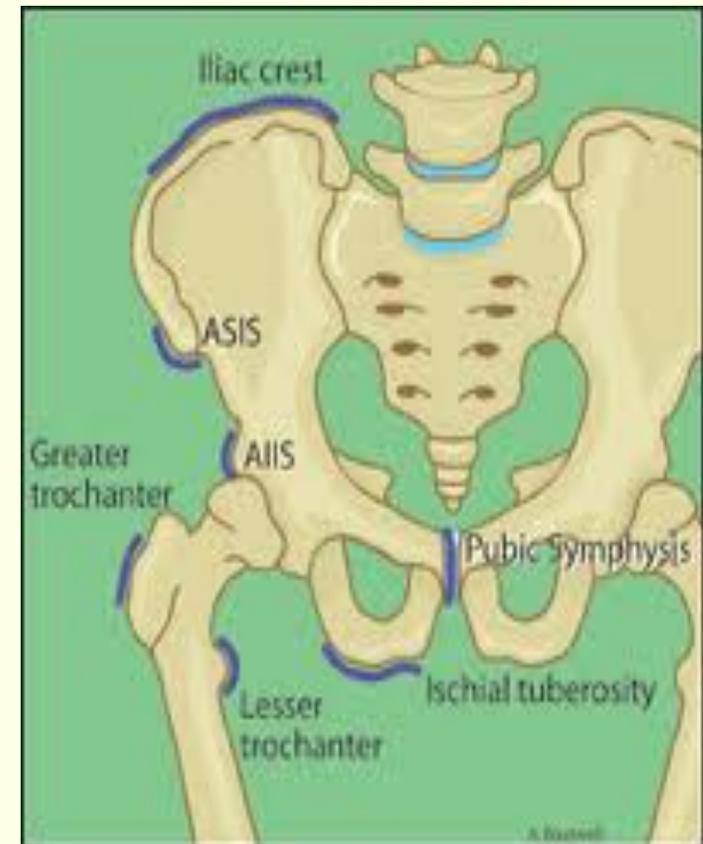


# Apophyseal Injuries: Hip/Pelvis

- 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

<u>Site</u>	<u>Attachments</u>
Iliac crest	Ext. obliques
ASIS	Sartorius
AIIS	Rectus femoris
G.Troch	Gluteus medius
L. Troch	Iliopsoas
Pubic symph	Adductors
Ischial tub.	Hamstrings



# Avulsion: Iliac crest and Lesser Trochanter



# Avulsion: ASIS and AIIS



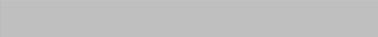
**FIGURE 1.** Fracture of the anterior inferior iliac spine in a 13-year-old boy

# Avulsion: Ischial Tuberosity

---



# Neurovascular Causes



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

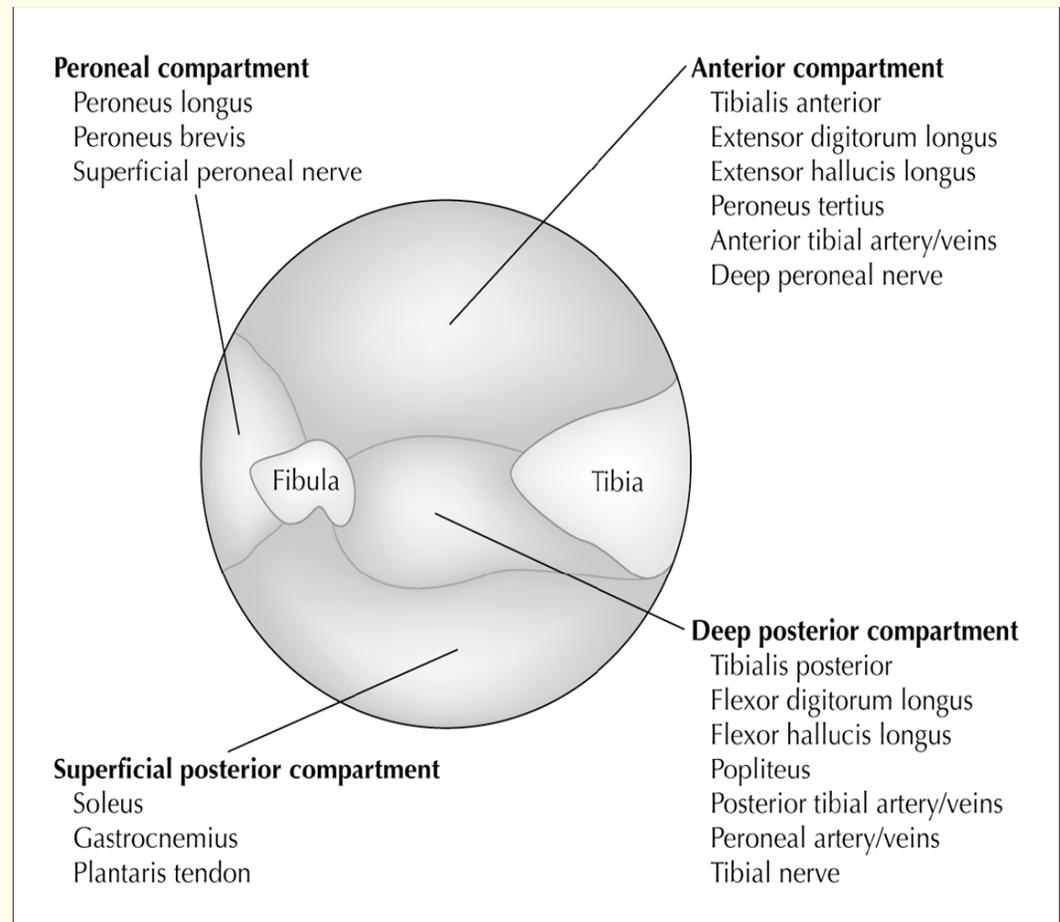
# Exertional Compartment Syndrome

- 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**

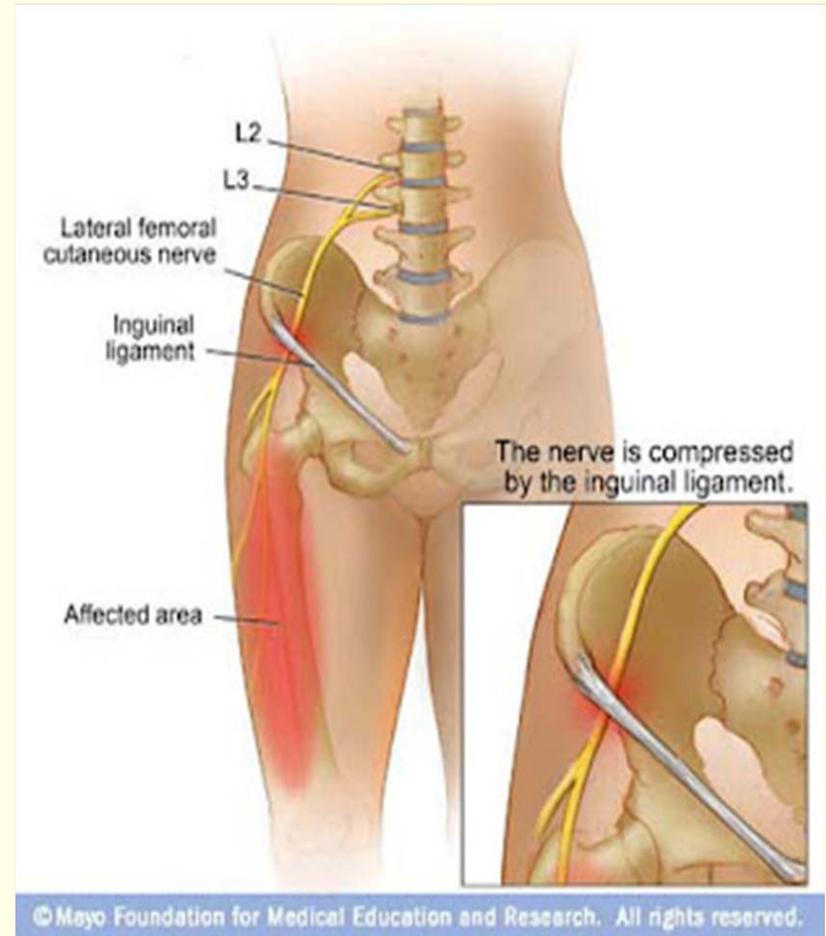
**Treatment typically involves compartment fasciotomy**



# 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 dyesthesias of the anterolateral thigh. Positive *Tinel's* medial to the ASIS

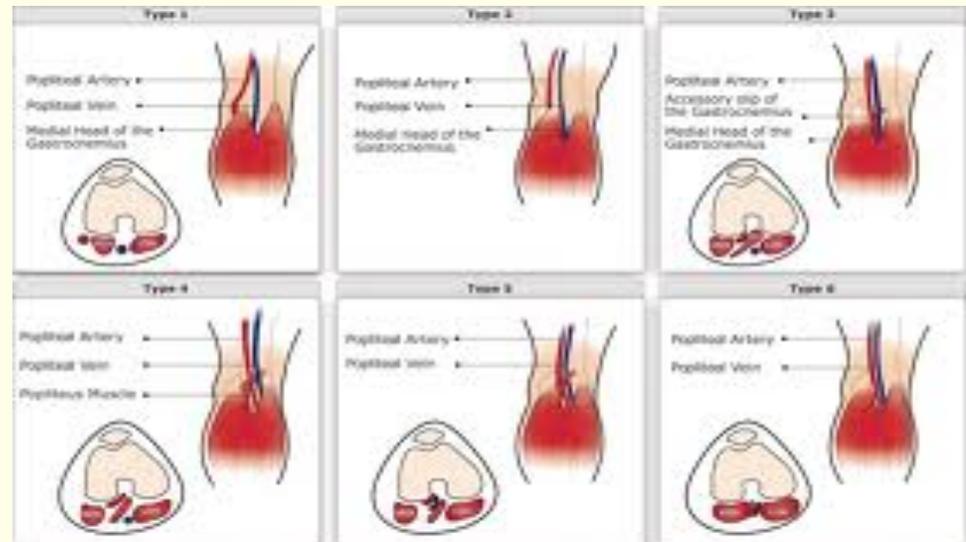


# Popliteal Artery Entrapment

**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**

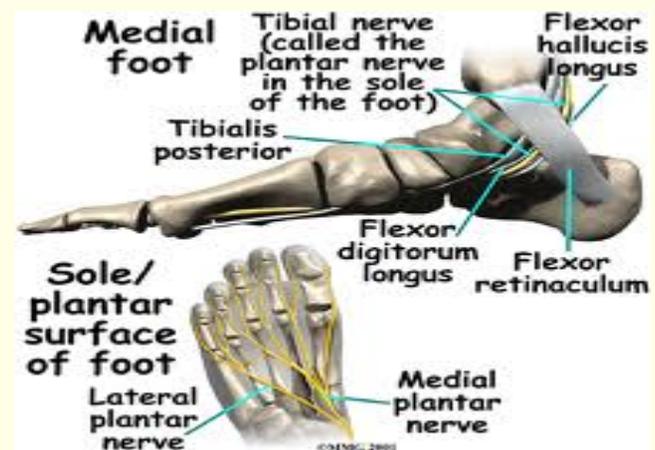


# Posterior Tibial Nerve Entrapment

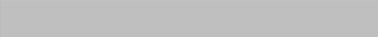
***Tarsal Tunnel Syndrome*** refers to various sites of entrapment of the nerve or its branches. Most occur distal to the ankle

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

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



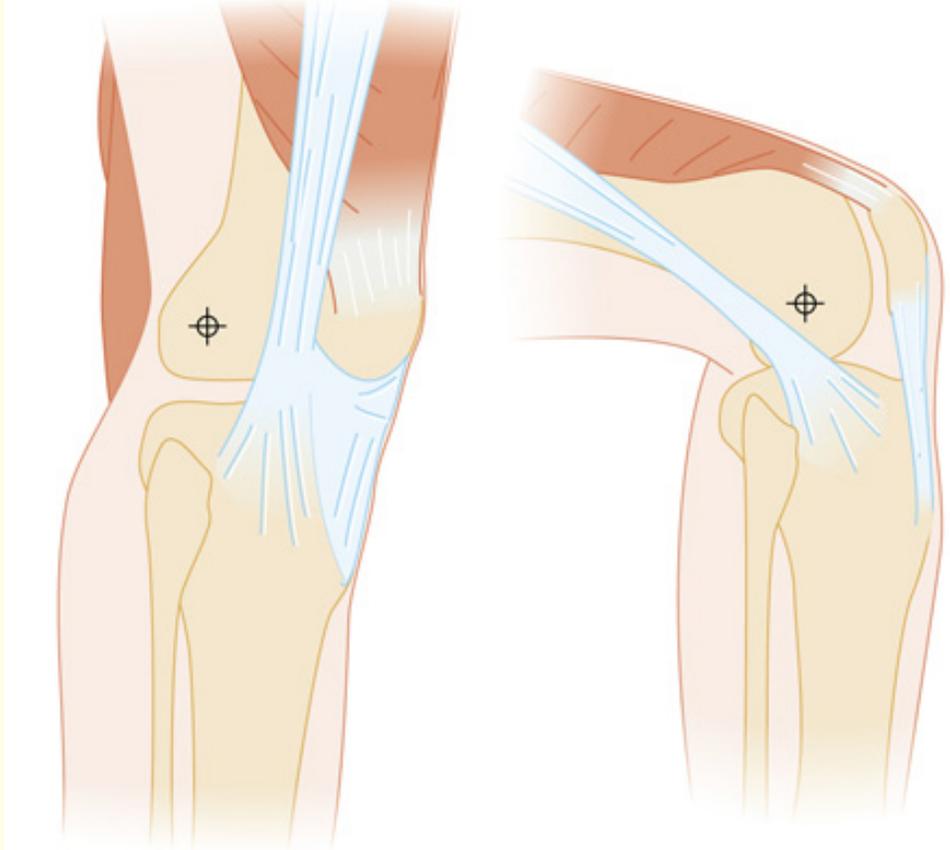
# Tendinopathies



- 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*.



Source: Tintinalli JE, Stapczynski JS, Ma OJ, Cline DM, Cydulka RK, Meckler GD:  
*Tintinalli's Emergency Medicine: A Comprehensive Study Guide, 7th Edition*:  
<http://www.accessmedicine.com>  
Copyright © The McGraw-Hill Companies, Inc. All rights reserved.

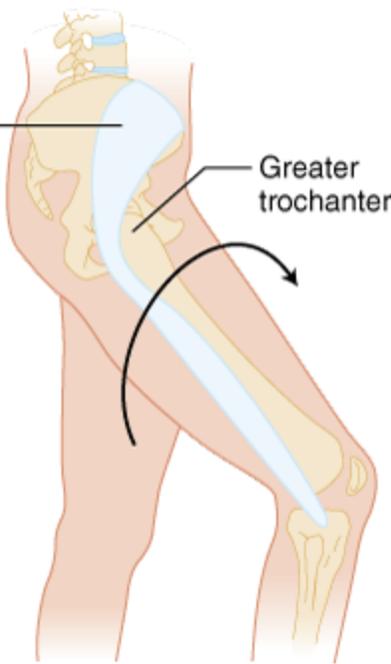
# Snapping Hip

External rotation



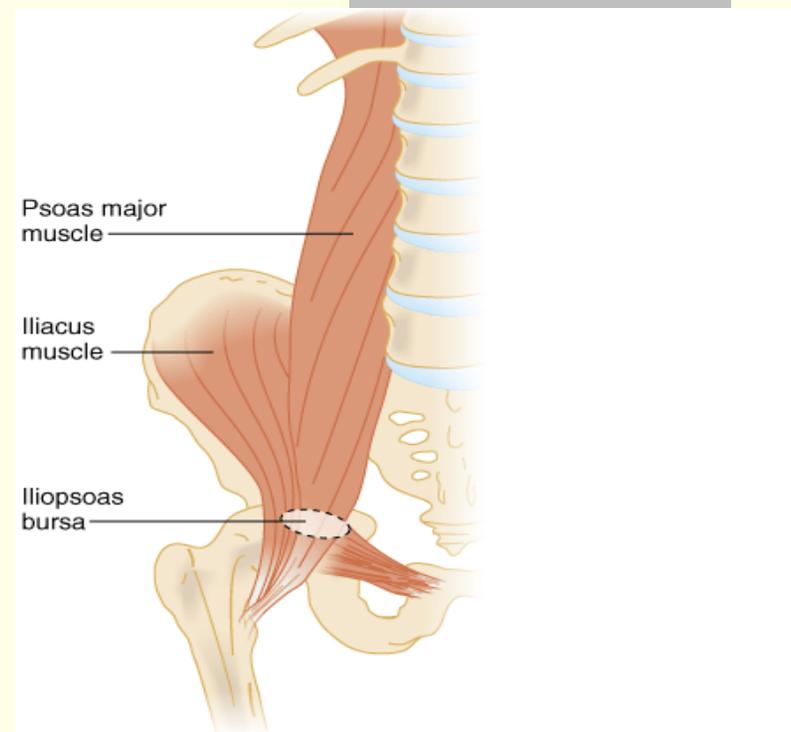
Iliotibial band  
Greater trochanter

External rotation



Greater trochanter

Source: Tintinalli JE, Stapczynski JS, Ma OJ, Cline DM, Cydulka RK, Meckler GD: *Tintinalli's Emergency Medicine: A Comprehensive Study Guide, 7th Edition*; <http://www.accessmedicine.com>  
Copyright © The McGraw-Hill Companies, Inc. All rights reserved.



Psoas major muscle  
Iliacus muscle  
Iliopsoas bursa

Source: Tintinalli JE, Stapczynski JS, Ma OJ, Cline DM, Cydulka RK, Meckler GD: *Tintinalli's Emergency Medicine: A Comprehensive Study Guide, 7th Edition*; <http://www.accessmedicine.com>  
Copyright © The McGraw-Hill Companies, Inc. All rights reserved.

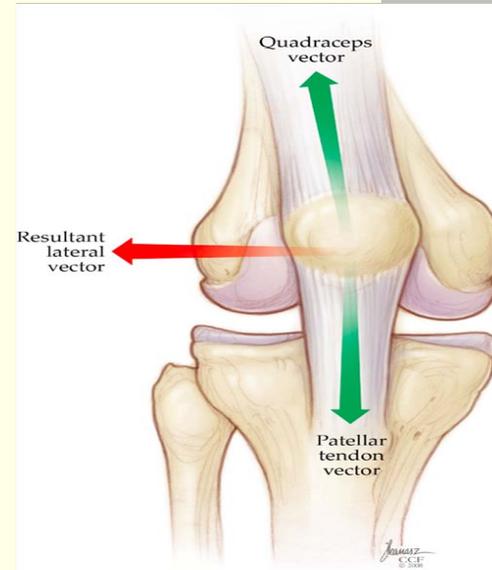
External snapping hip syndrome: the iliotibial band courses over the greater trochanter.

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

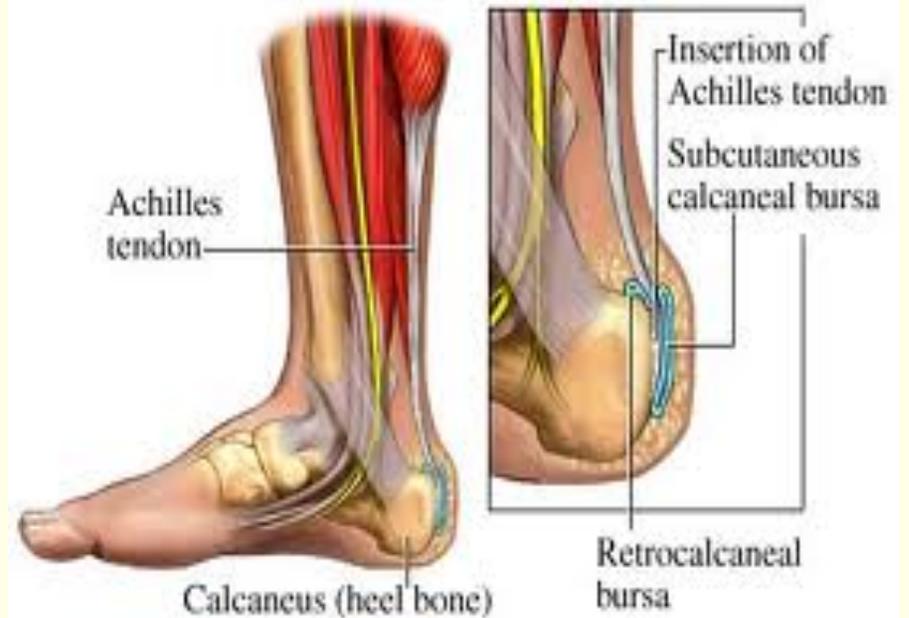
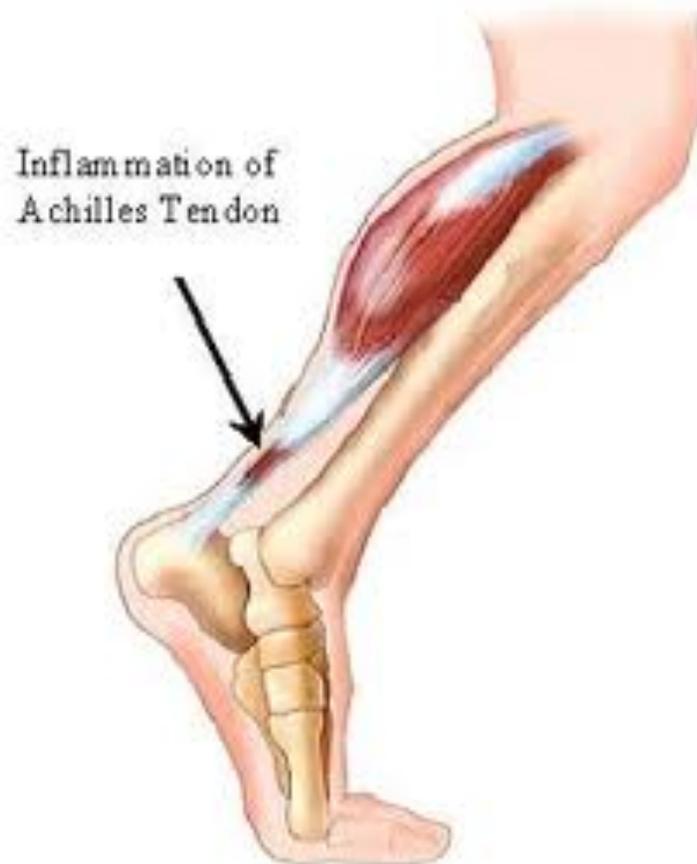
# Malacious Malalignment



# 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



# 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

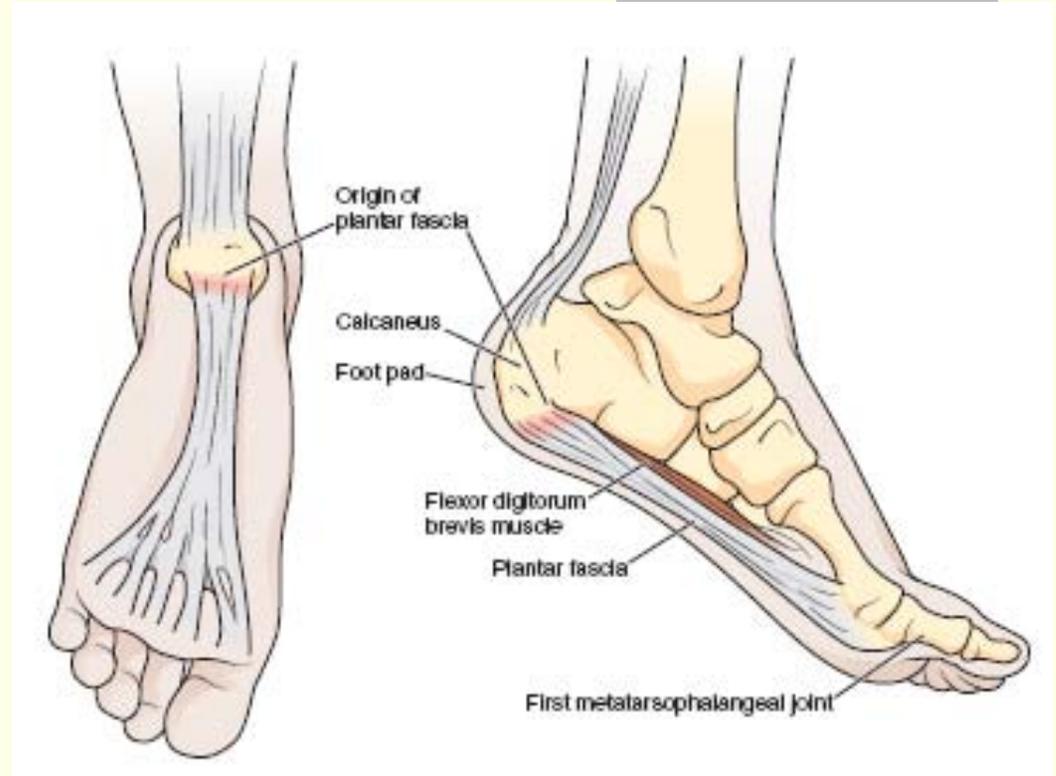
# Prevention

- 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

# Thank

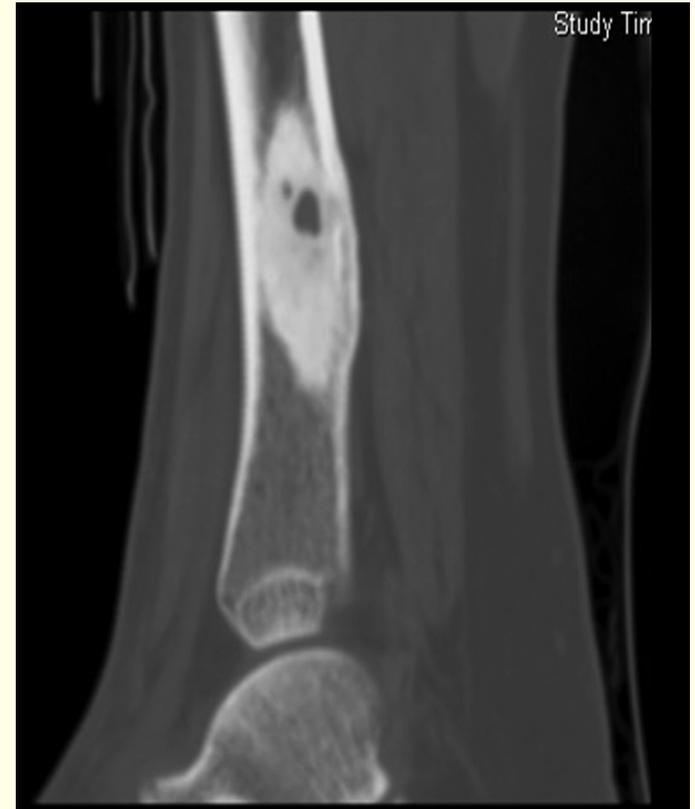


# Plantar Fasciitis



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

- Arnaiz J et al. Imaging Findings of Lower Limb Apophysitis. AJR 2011;196:W316-W325
- 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
- Bui-Mansfield L T et al. Osteochondritis Dissecans of the Tibial Plafond: Imaging Characteristics and a Review of the Literature. AJR 2000;175:1305-1308
- Rauh, Michael A., and Richard D. Parker. "Ch. 22 Patella." *DeLee: DeLee and Drez's Orthopaedic Sports Medicine*. 3rd ed. Philadelphia: Saunders, 2010.
- Hosey R.G., Nikovits D.A., Rodenberg R.E., Armsey T.D., Black W. (2011). Chapter 38. Common Upper & Lower Extremity Fractures. In J.E. South-Paul, S.C. Matheny, E.L. Lewis (Eds), *CURRENT Diagnosis & Treatment in Family Medicine*, 3e. Retrieved October 8, 2012 from <http://www.accessmedicine.com/content.aspx?aID=8155119>.
- O'Keefe K.P., Sanson T.G. (2011). Chapter 278. Hip and Knee Pain. In J.E. Tintinalli, J.S. Stapczynski, D.M. Cline, O.J. Ma, R.K. Cydulka, G.D. Meckler (Eds), *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*, 7e. Retrieved October 8, 2012 from <http://www.accessmedicine.com/content.aspx?aID=6392671>.
- O'Keefe K.P., Sanson T.G. (2011). Chapter 278. Hip and Knee Pain. In J.E. Tintinalli, J.S. Stapczynski, D.M. Cline, O.J. Ma, R.K. Cydulka, G.D. Meckler (Eds), *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*, 7e. Retrieved October 8, 2012 from <http://www.accessmedicine.com/content.aspx?aID=6392671>.
- Menkes J.S. (2011). Chapter 264. Initial Evaluation and Management of Orthopedic Injuries. In J.E. Tintinalli, J.S. Stapczynski, D.M. Cline, O.J. Ma, R.K. Cydulka, G.D. Meckler (Eds), *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*, 7e. Retrieved October 8, 2012 from <http://www.accessmedicine.com/content.aspx?aID=6390597>.
- Brown, Jr. C.R. (2007). Chapter 62. Common Injuries from Running. In J.B. Imboden, D.B. Hellmann, J.H. Stone (Eds), *CURRENT Rheumatology Diagnosis & Treatment*, 2e. Retrieved October 8, 2012 from <http://www.accessmedicine.com/content.aspx?aID=2729862>.

# References

- Miner Haygood T., Sayyoub M.M. (2011). Chapter 6. Musculoskeletal Imaging. In M.Y. Chen, T.L. Pope, D.J. Ott (Eds), *Basic Radiology*, 2e. Retrieved October 8, 2012 from <http://www.accessmedicine.com/content.aspx?aID=6669646>.
- 
- 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
- Andreisek G et al. AJR 2009;193:W327-W333
- 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



Left: AP radiograph of the proximal femur of a 20-year-old U.S. Navy S.E.A.L. trainee illustrates a compression-side femoral neck fatigue fracture.



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.

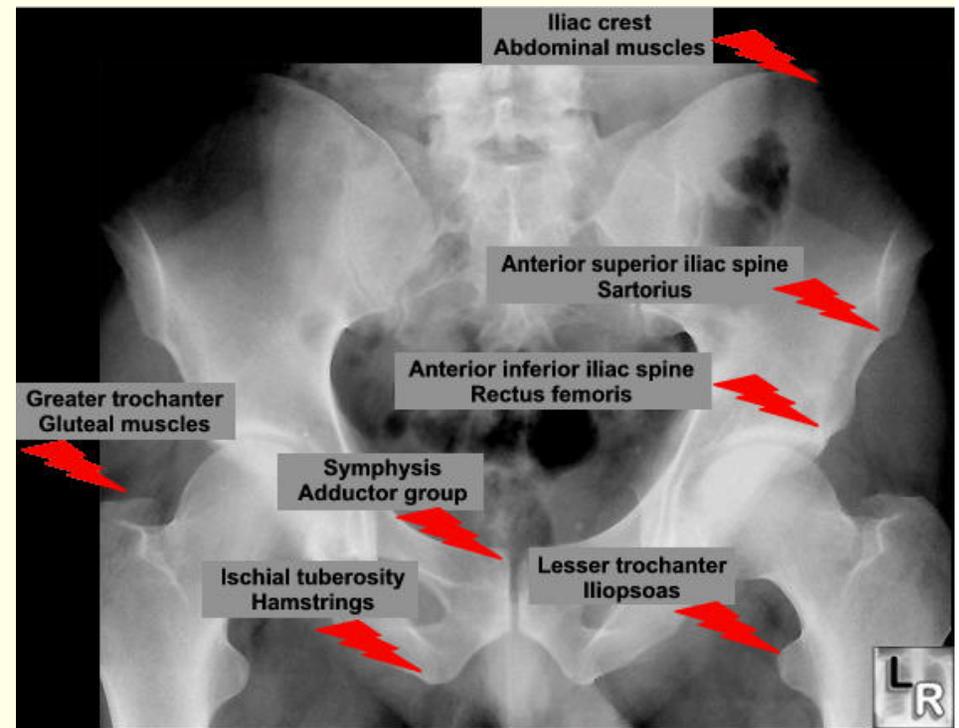




- Deuschländer's disease, the first report of a stress fracture is credited to Breithaupt, a Prussian military physician, who described it in 1855.
- He described foot pain and swelling in new military recruits, and the metatarsal fractures he observed are now commonly called *march fractures*.

# 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.



## Specific Apophysal Avulsion Injuries—Cont'd

Site	Muscle Attachment	Clinical Information	Management
Lesser trochanter	Iliopsoas	Most commonly seen in sprinters jumpers, or kicking athletes Local tenderness and hip held in slight adduction and internal rotation; positive Ludloff's sign (inability to flex hip when in seated position)	Nonsurgical
Greater trochanter	Gluteus medius gluteus minimus, short external rotators	Caused by forceful muscular contraction of hip abductors, e.g., during cutting activities Local tenderness, positive Trendelenburg's gait and sign and pain on resisted abduction and passive adduction	Nonsurgical; consider surgery if >1 cm displacement
Pubic symphysis	Adductor group	Most commonly seen in sprinters Local tenderness along anterior, pubis and pain on resisted hip adduction and passive hip abduction	Nonsurgical

# Physical 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



A

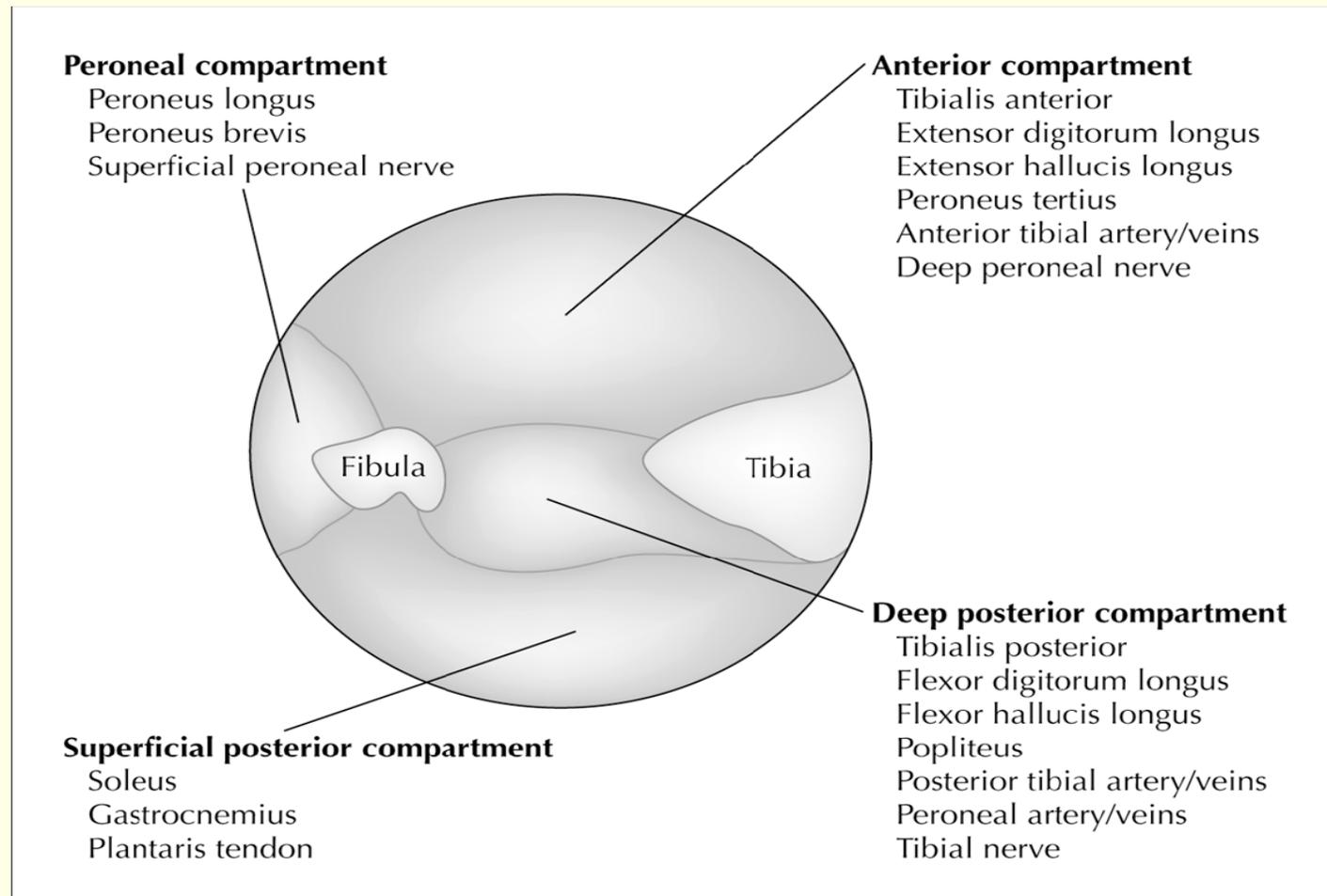


B

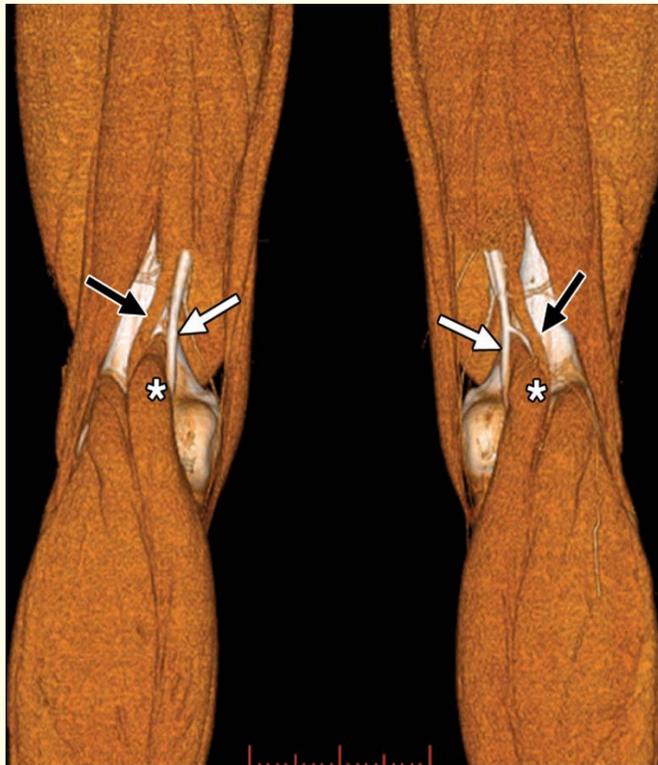
Source: Skinner HB: *Current Diagnosis & Treatment in Orthopedics*,  
4th Edition: <http://www.accessmedicine.com>  
Copyright © The McGraw-Hill Companies, Inc. All rights reserved.

- 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



# Popliteal A. Entrapment Syndrome

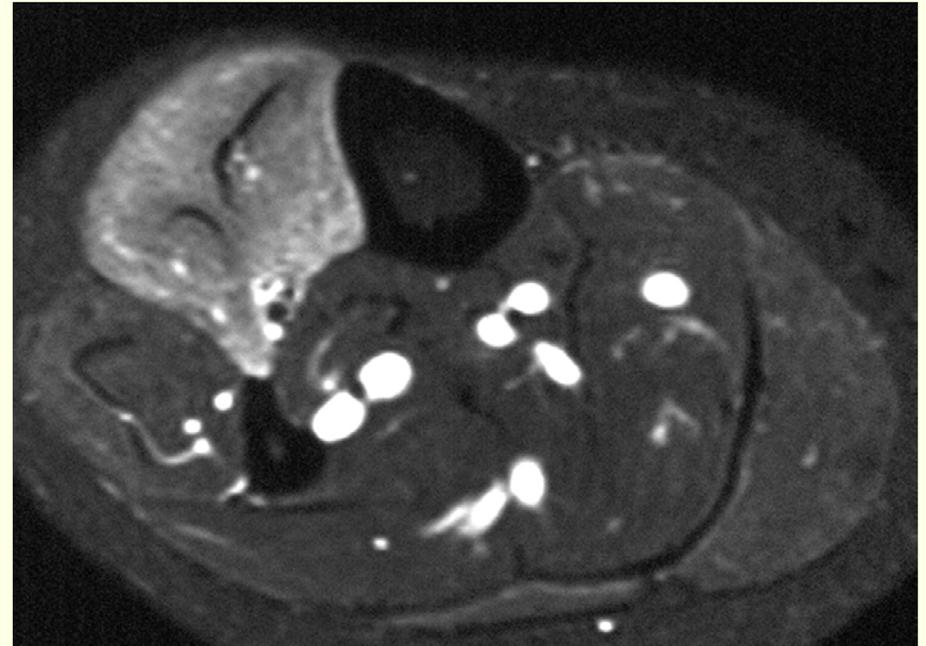
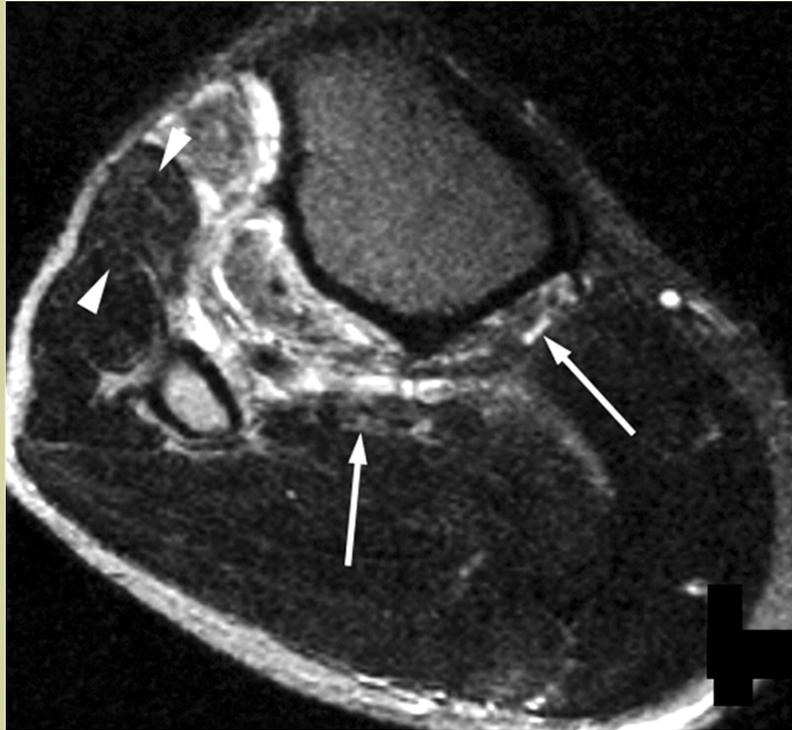


19-year-old man with popliteal vascular entrapment syndrome who presented appeared with hard exercise and abated with rest.

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.

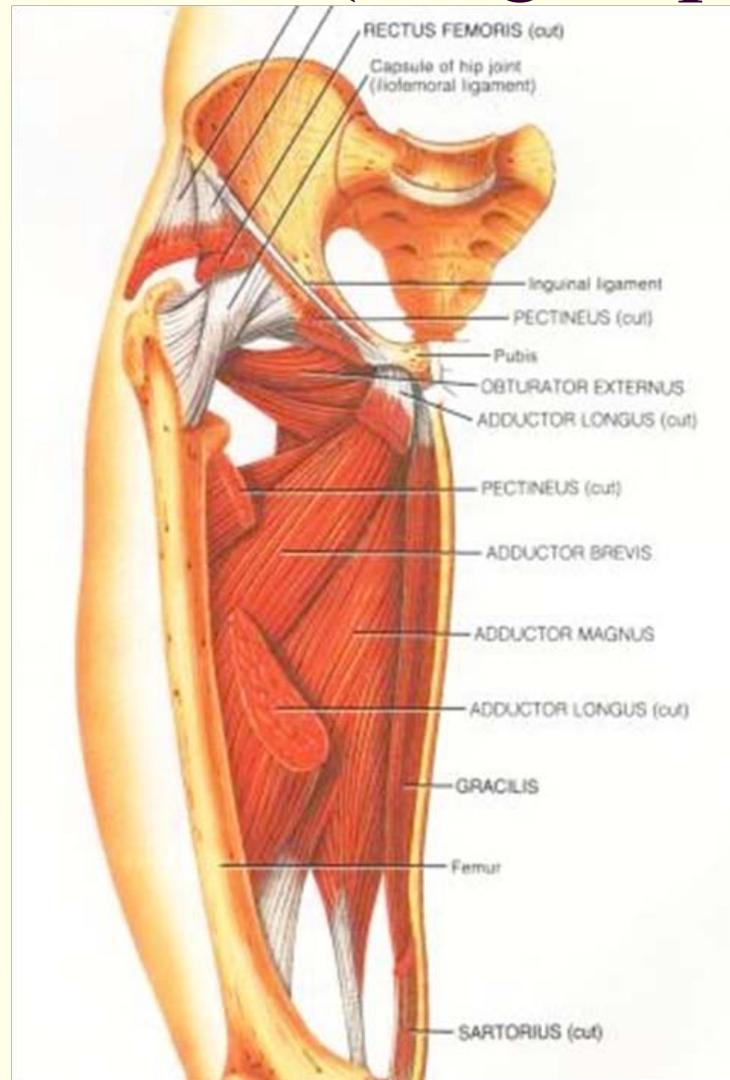
## Chronic compartment syndrome in long distance runners



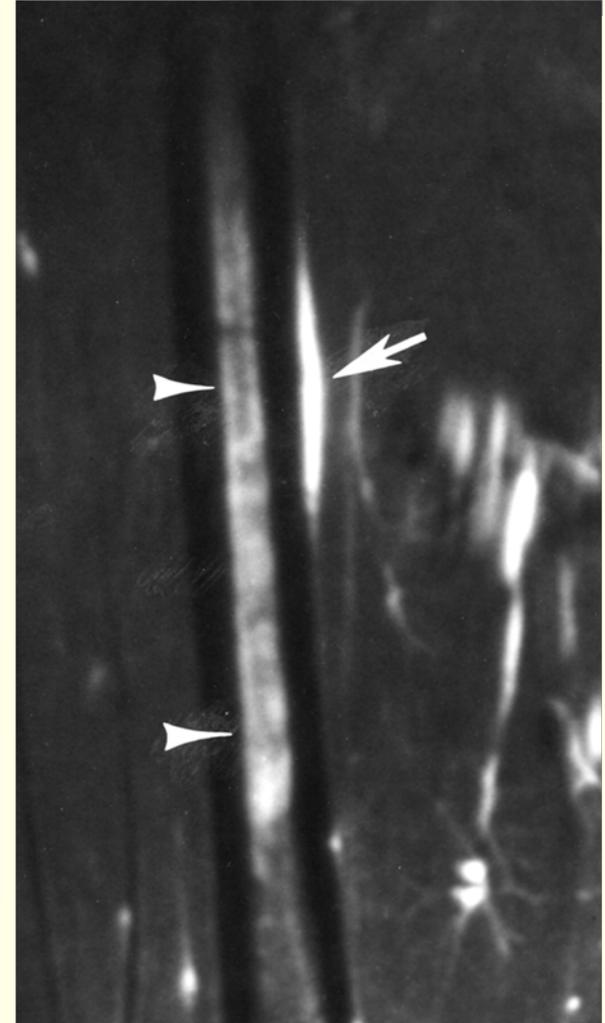
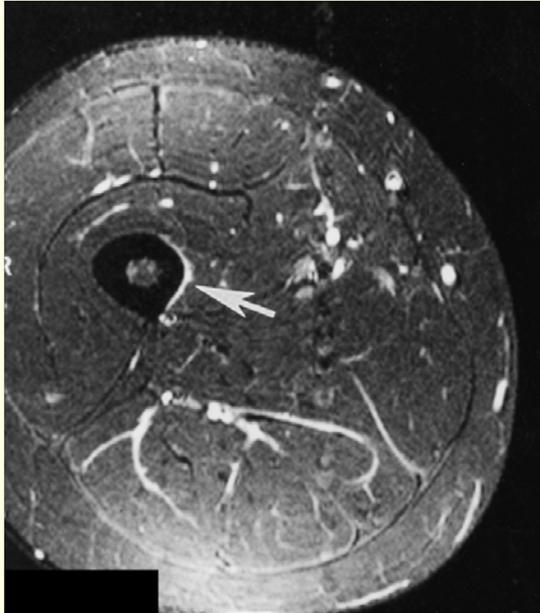
Left: Chronic compartment syndrome in 30-year-old man who was runner. Fat-saturated T2-weighted axial MR image, obtained immediately after exercise, shows evident edema of tibial anterior and deep posterior compartment muscles (arrows). Slight, questionable hyperintensity can be seen in other muscles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



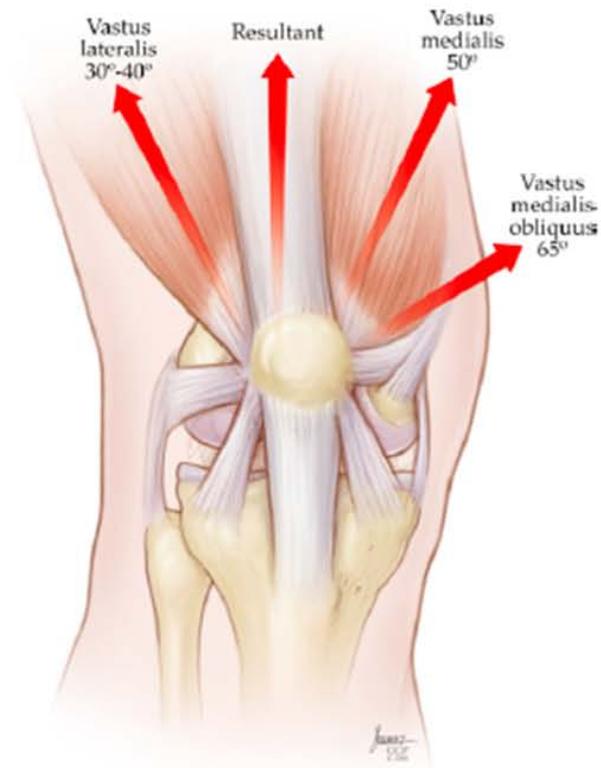
19-year-old female lacrosse player with right thigh pain.



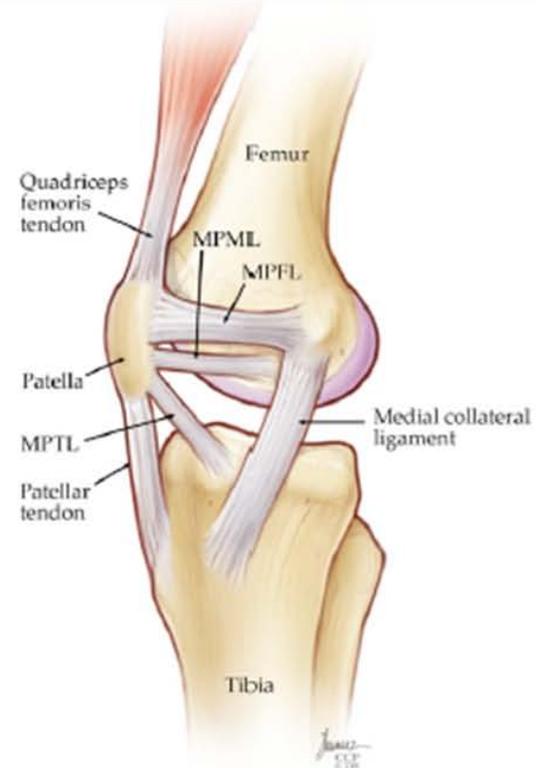
## Chronic hypertrophic demyelinating neuropathy of the common peroneal nerve



# Medial patellofemoral ligaments



**Figure 22C2-7** Quadriceps musculature. (Reprinted with the permission of The Cleveland Clinic Center for Medical Art & Photography © 2008.)



**Figure 22C2-8** Medial patellofemoral ligaments. MPFL, medial patellofemoral ligament; MPML, medial patellomeniscal ligament; MPTL, medial patellotibial ligament. (Reprinted with the permission of The Cleveland Clinic Center for Medical Art & Photography © 2008.)

# Medial Tibial Stress Syndrome

