



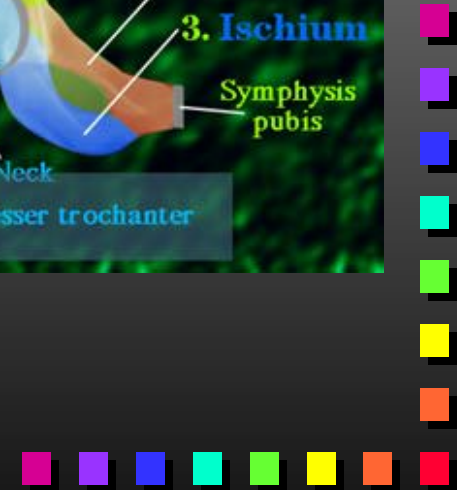
## Injuries to the Lower Extremity

Most common due to application of large loads. Important because of the role on the lower extremity in locomotion



# Hip Anatomy

- Ball & Socket (3D)
- Ligament support
  - Iliofemoral
  - pubofemoral
  - ischiofemoral
  - ligamentum teres
- Joint capsule: labrum



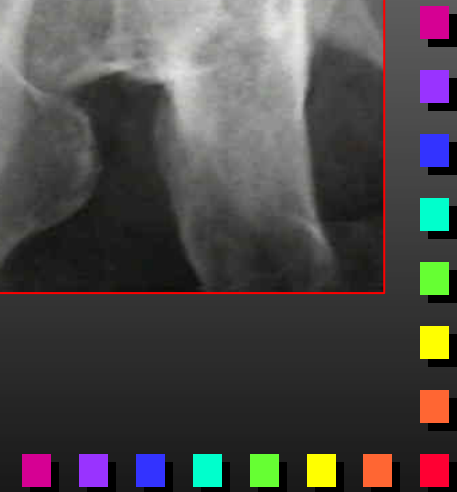
# Hip Muscles

	Flexion	Extension	Abduction	Adduction	Int. Rotation	Ext. Rotation
Adductors				X		X
Tensor fascia	X		X		X	
Gluteus Max		X				X
Gluteus Medius			X		X	
Gluteus Minimus			X		X	
Gracilis				X		
Iliopsoas	X					
Pectineus	X			X		X
Piriformis		+	+			X
Hamstrings		X				
Sartorius	X					
Rectus Femoris	X					



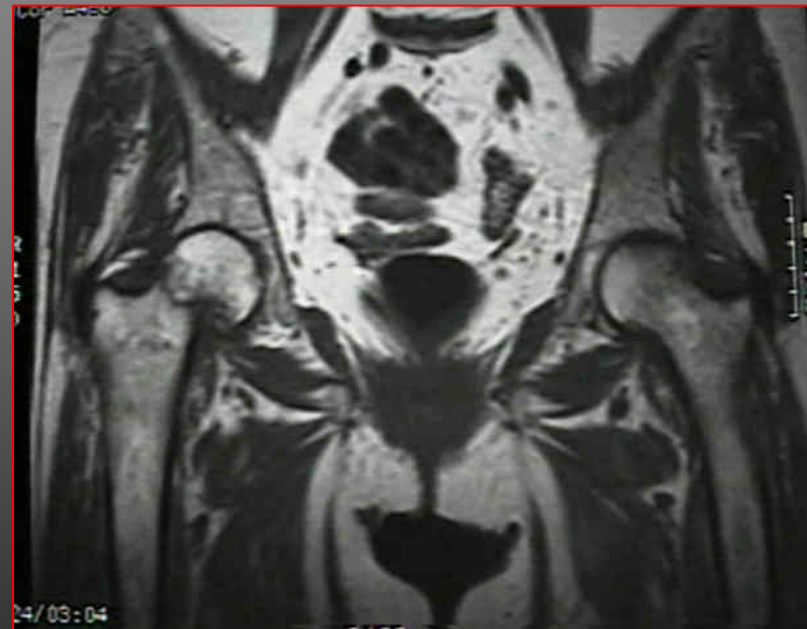
# Hip fractures

- High energy forces
  - falls
  - car accidents
  - pelvic (side impacts)
    - high mortality rates
- Femoral neck fractures
  - > 250,000
  - women 3 times likely to get fracture



# Hip fractures

- Young people: high energy impacts
- Mechanism
  - direct impact
  - lateral rotation of leg
- Stress fractures femur
- Dynamic models of falls
  - impact forces 3-10 kN



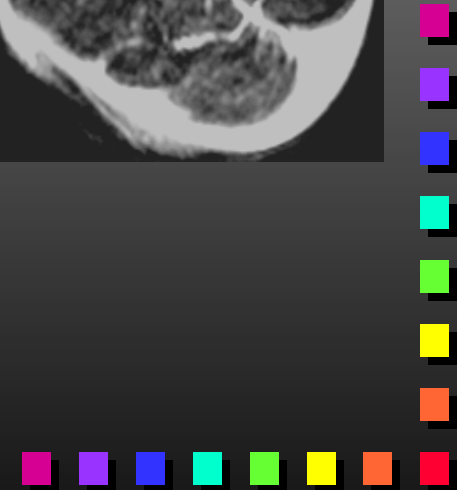
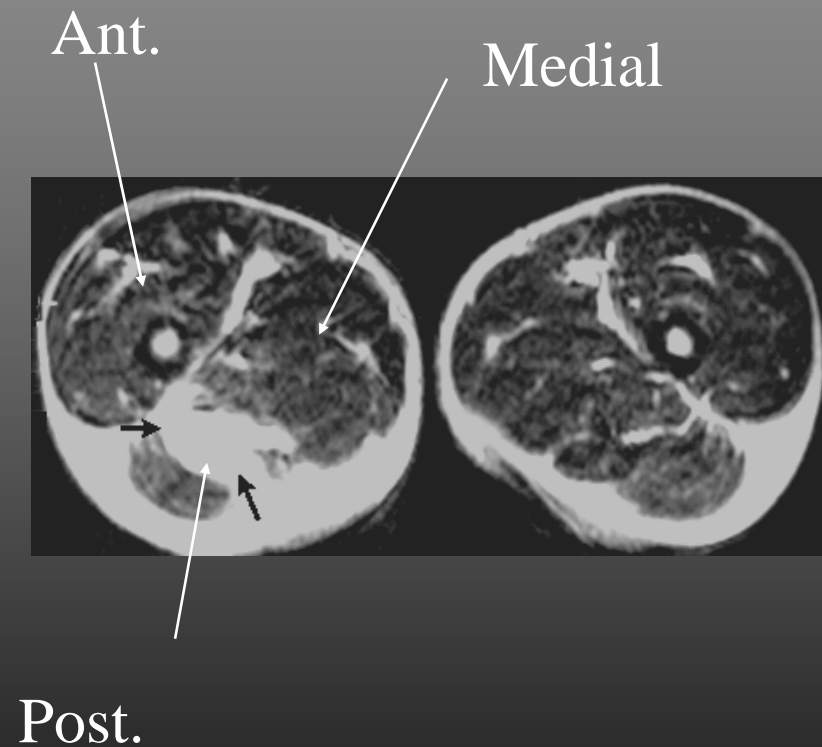
# Hip Luxation (dislocation)

- Not common: hip stability
- High forces
- Most cases posterior dislocation
- Car accidents: dashboard
- Anterior inferior dislocation
  - 10-20% of hip dislocation
  - Force abduction
  - Abduction, flexion and ext. rotation (obturator)
- Hip retroversion (toe-in)
- Congenital dislocation (infants)



# Thigh injuries

- Three muscular compartments
  - anterior
  - medial
  - posterior
- Quadriceps contusion
  - blunt trauma
  - extensive hematoma
  - swelling
  - increase muscle weight
  - loss of strength
- Myositis Ossificans



# Femoral fractures

- High energy trauma
  - car & motorcycle and or pedestrian accidents (78%)
- Classified by location, configuration and level of comminution
- Dangerous near epiphyseal plates





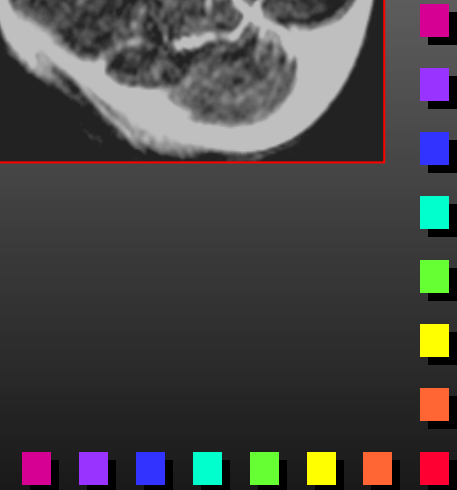
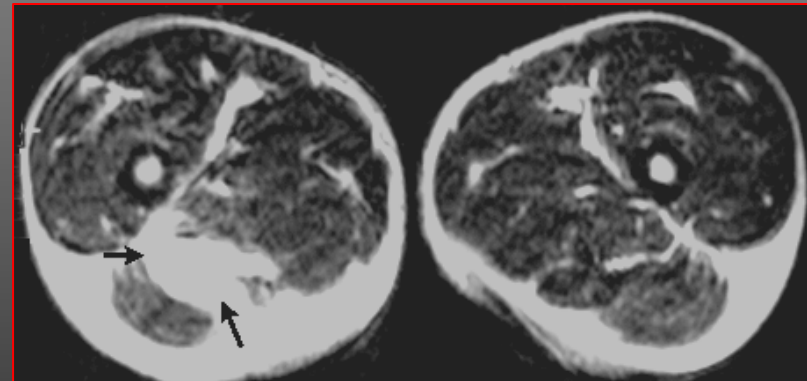
# Femoral fractures

- Gunshot fractures affected by bullet diameter, velocity, weight, shape, and tumbling
- Low-velocity
  - splintering
- High velocity or close range shotgun blasts
  - More soft tissue damage
- Torsional loading
  - young skiers
  - high skill level (risk)



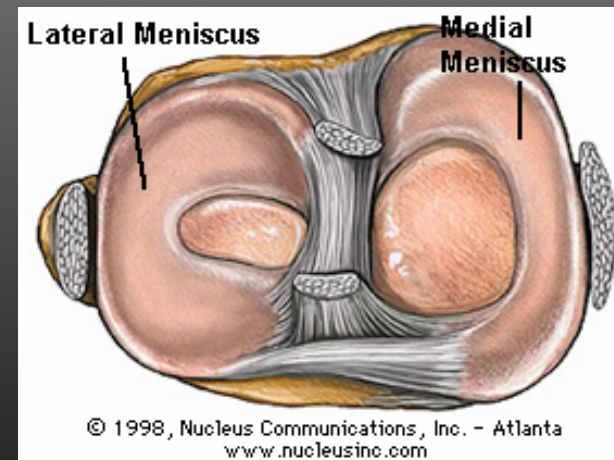
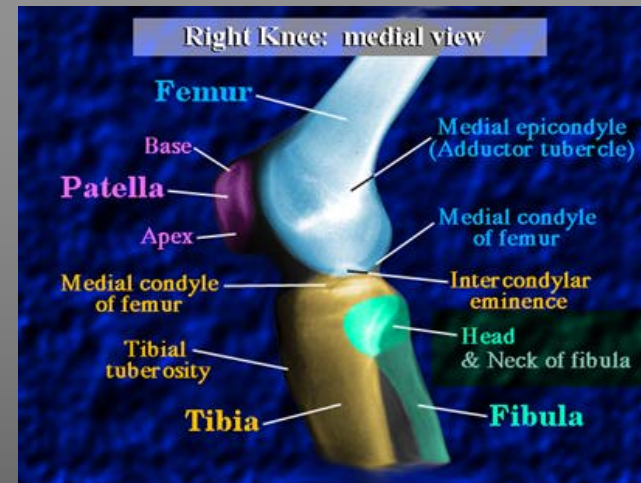
# Hamstring

- Excessive tension applied to the muscle
  - eccentric action
- Predisposing factors:
  - fatigue
  - muscle imbalance
  - lack of flexibility
  - lack of warm up
- Biarticular muscles
  - bicep femoris
  - MTJ



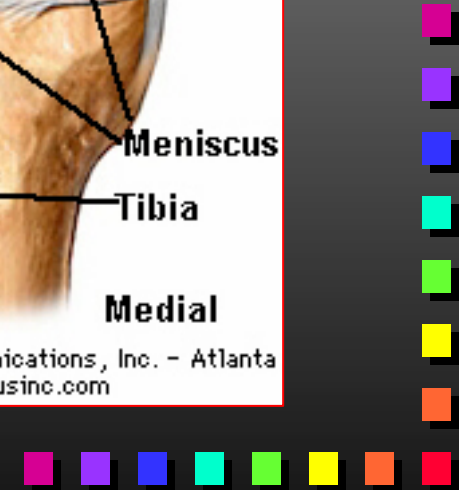
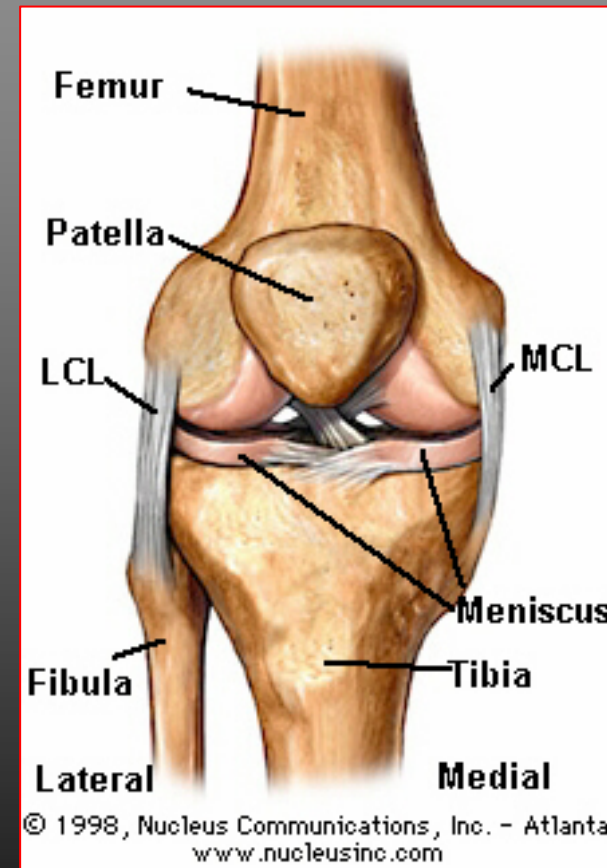
# Knee anatomy

- Three joints
  - Tibiofemoral joints
  - Patellofemoral joints
- Double condyloid
  - flexion/extension
  - rotation
- Poor joint cavity
- Meniscus
  - connect to joint capsule and MCL and sometimes with ACL
  - Lateral: loose attachment



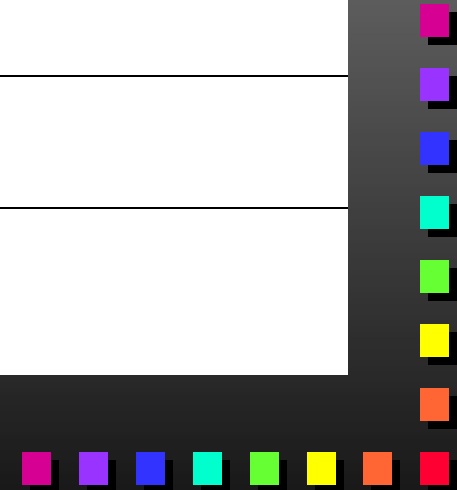
# Knee Anatomy

- Strong ligament support
  - collateral lig: resist valgus and varus loading
  - ACL: two bundles, restrict anterior motion of tibia, valgus, varus, rotation
  - PCL: two bundles, restrict posterior motion of the tibia, limits hyper flexion
- Patella: mechanical advantage
  - PFJ huge loads when knee is flexed



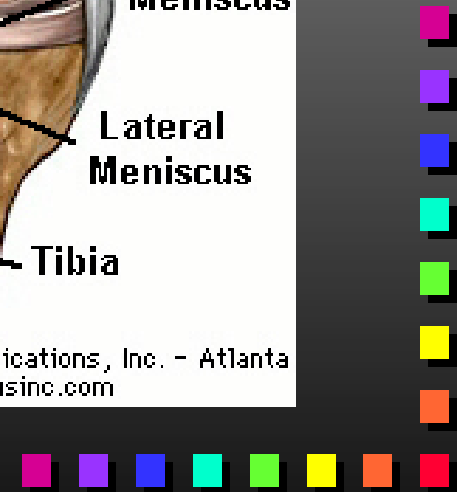
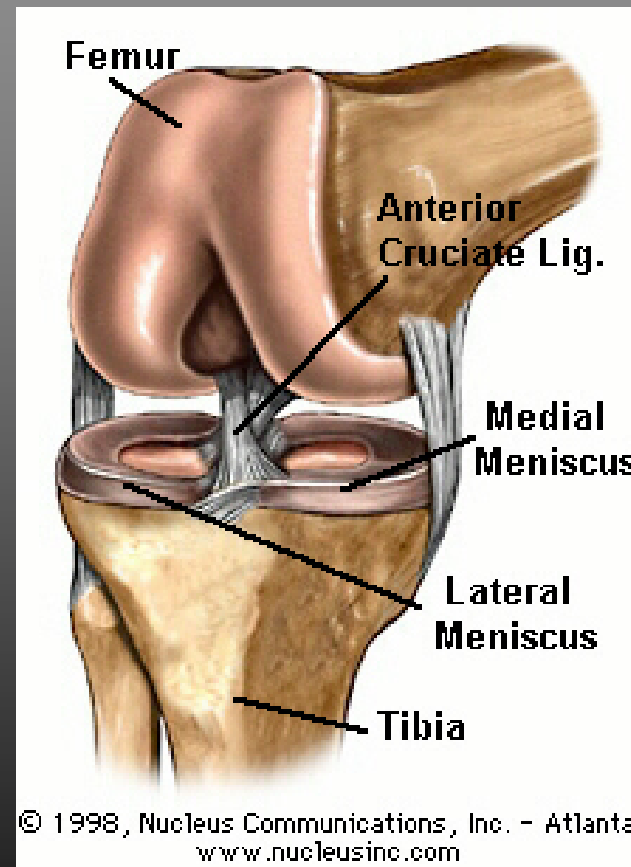
# Knee Anatomy

Muscle	Action
Gracilis	Flexes the leg
Sartorius	Flexes the leg
Quadriceps	Extends the leg
Hamstrings	Flexes the leg



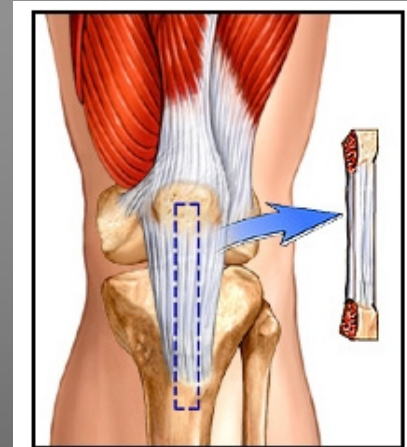
# Knee Injuries

- ACL sprain: more common than PCL
- Mechanism:
  - valgus loading and ext tibial rotation (cutting movements)
  - hyperextension and internal tibial rotation (landing from jumps/rotate)
- MRI triad: ACL rupture, osseous lesion of terminal sulcus, and bone or soft tissue.

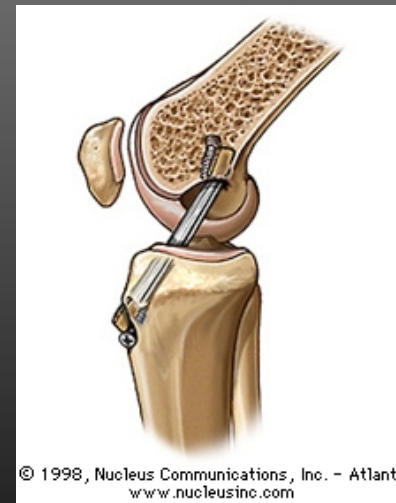


# Knee Injuries

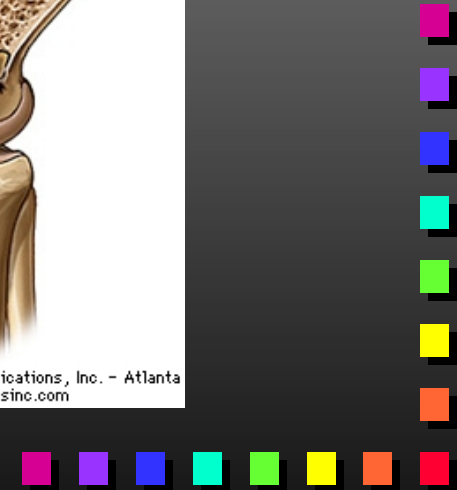
- ACL & Skiers
  - backward fall
    - Anterior drawer mechanism
  - Phantom boot
    - back of skis levers flexed knee into internal rotation
- ACL and females ?



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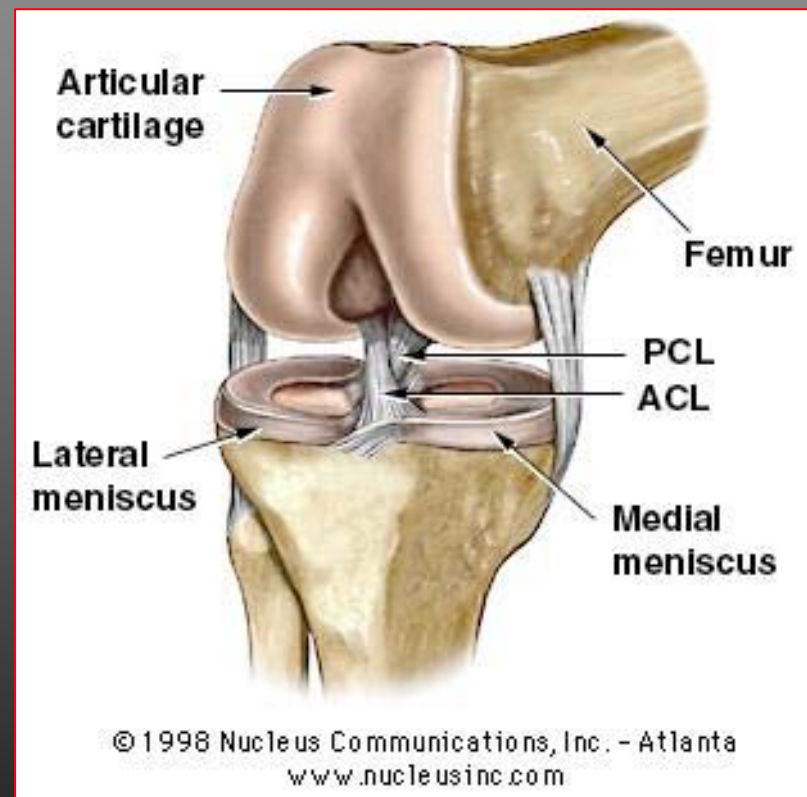


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# Knee Injuries

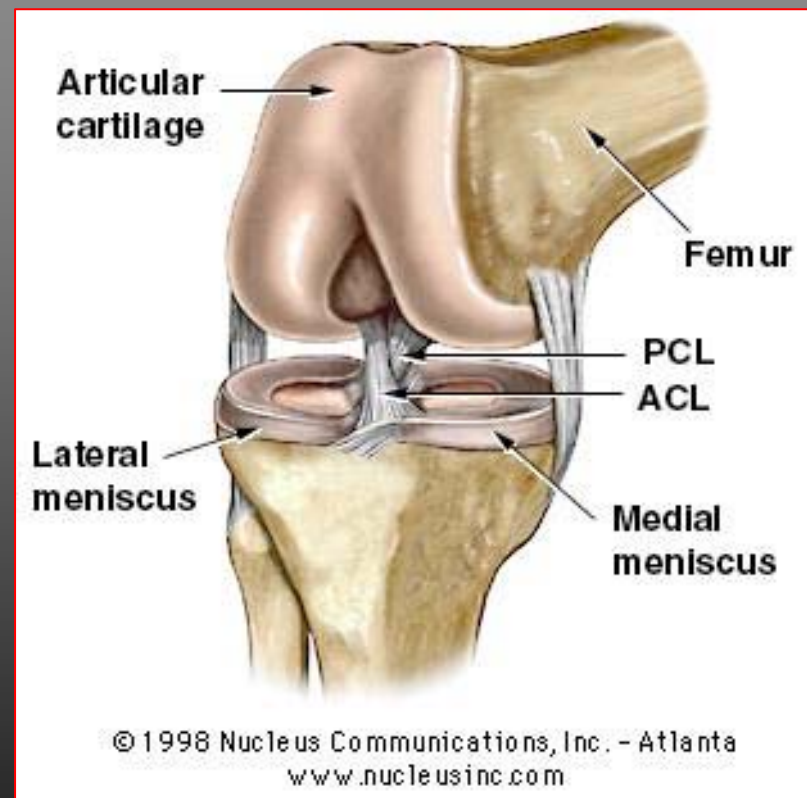
- PCL lower incidence of injuries
  - half of cause due to direct trauma car accidents
  - Sports
- Mechanism
  - unrestrained occupant thrown against dashboard
  - fall on flexed knee with plantar flexed knee
  - force knee flexion
  - force knee hyperextension
  - quick rotation





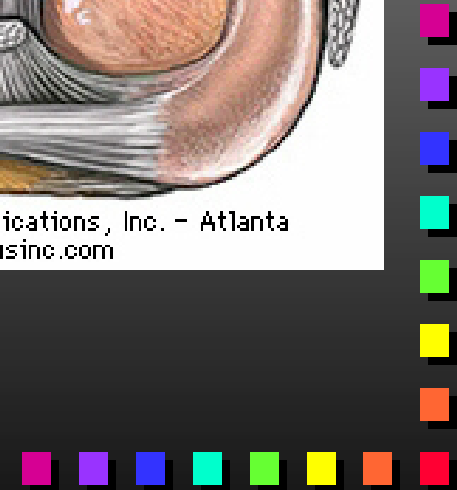
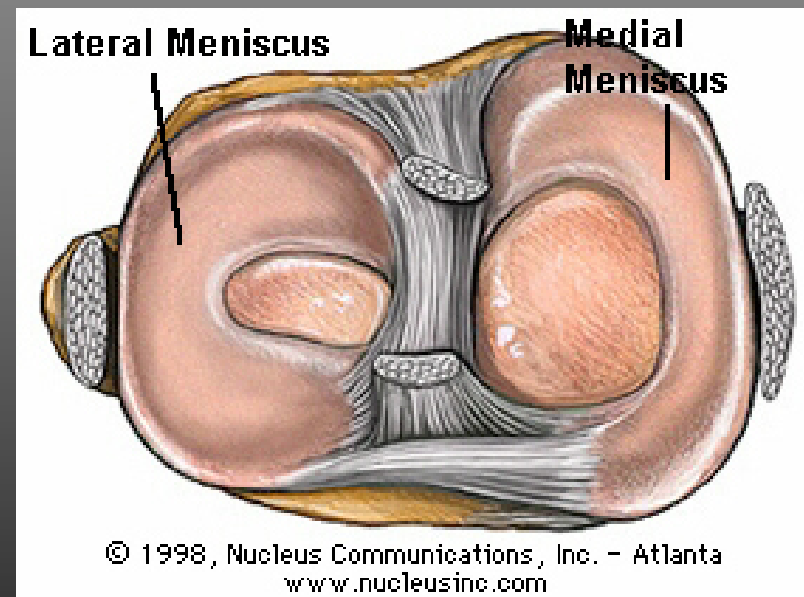
# Knee injuries

- Unhappy triad: valgus-external rotation
  - ACL
  - MCL
  - Medial meniscus damage ?



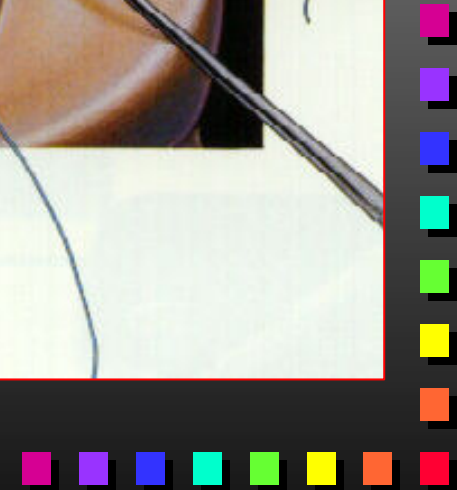
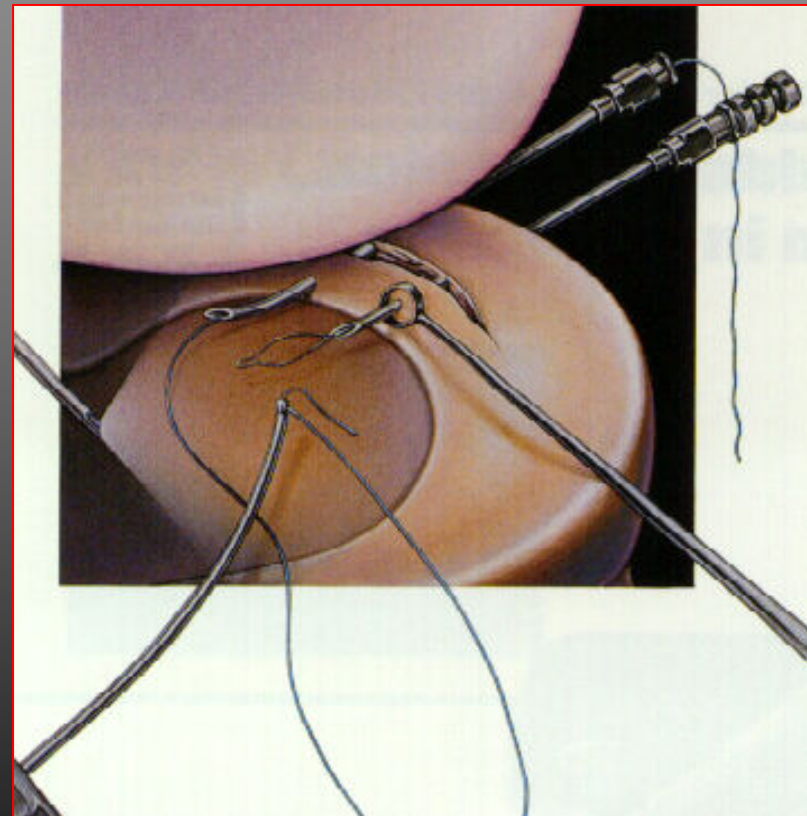
# Knee Injuries

- Meniscus:
  - weight bearing
  - shock absorption
  - stabilization
  - rotational facilitation
- Full extension
  - 45-50% of the load
- 90° flexion
  - 85% load
- Laterally: 70% of the load  
30% AC



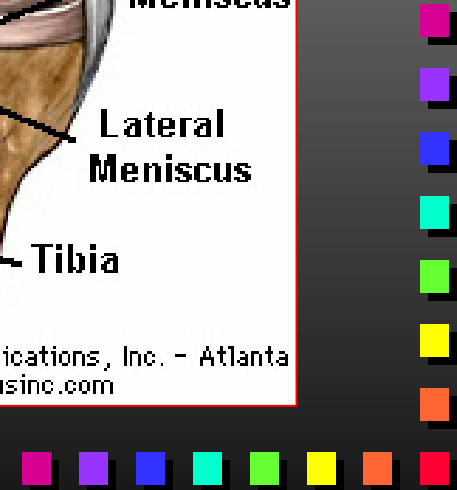
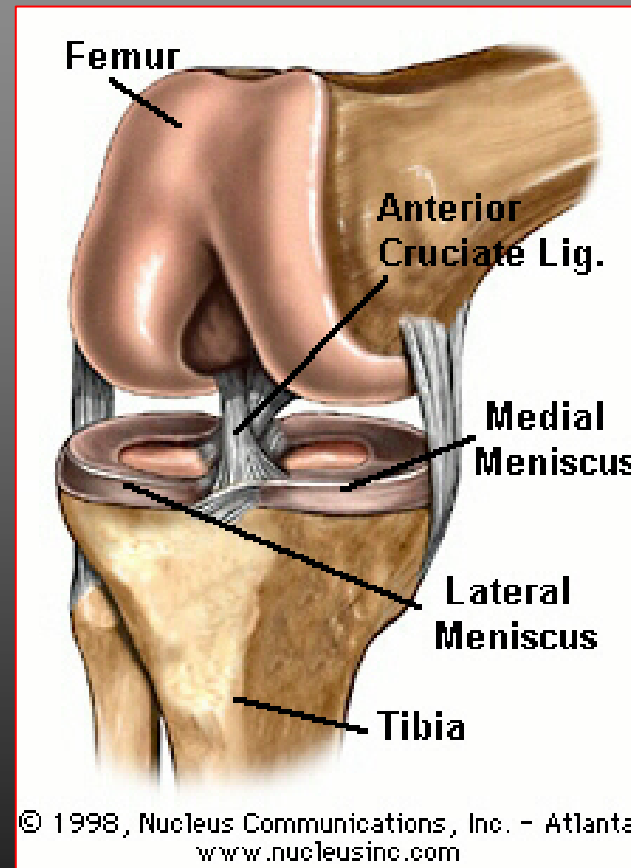
# Knee Injuries

- Screw home mechanism: medial rotation at full extension
- Mechanism
  - flexion or extension and rotation
  - tensile loading of medial meniscus
  - bucket-handle tear
- High incidence sports
  - soccer, shot put discuss, skiing



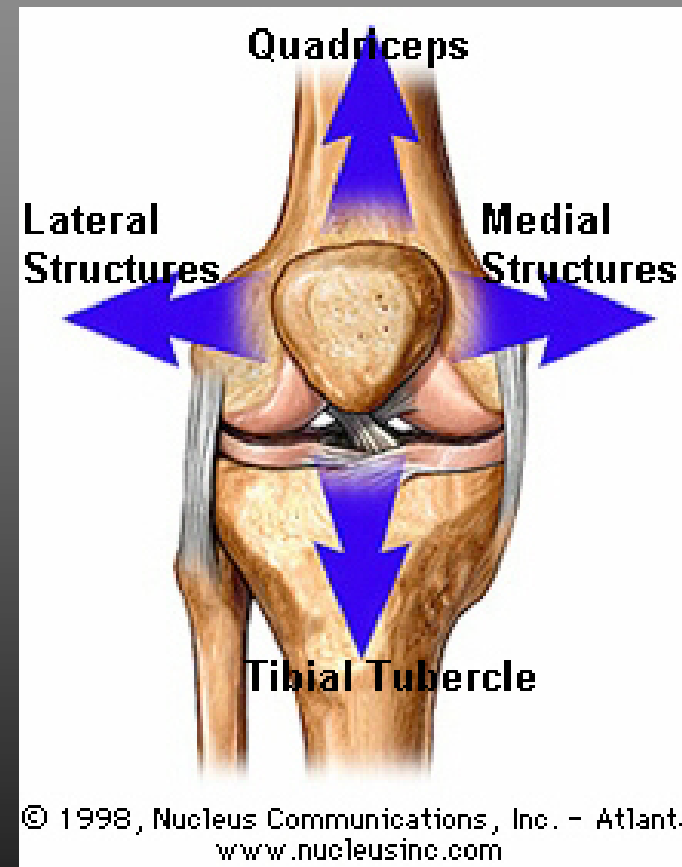
# Knee injuries

- MCL and LCL sprains
- Forced varus or valgus loading
- Overuse
  - breaststroke kick



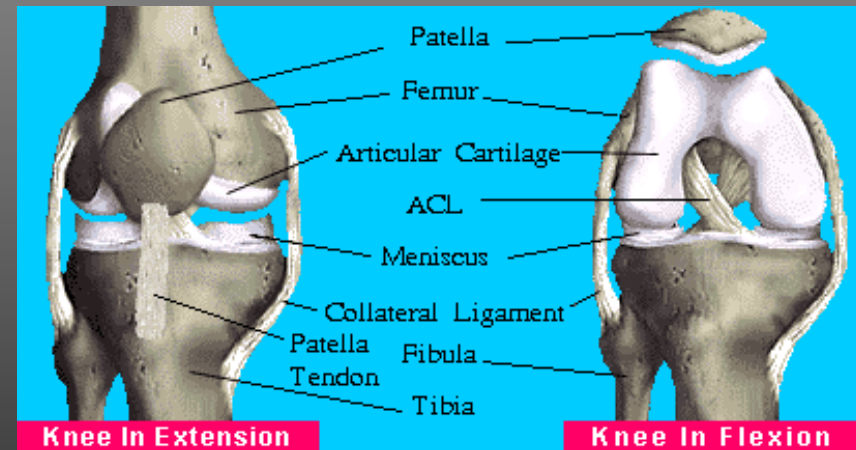
# Knee injuries

- KEM: knee extensor mechanism
  - quads
  - PFJ and tendon
- Difference forces in the quad tendon and patellar ligament
  - Depend on Knee angle
  - Contact force
- Patellar tracking
  - Q angle
  - Congruence



# Knee Injuries

- Jumper's Knee
  - Patellar tendon pain
- Chondromalacia
  - degeneration of the retropatellar AC
- Tendon Rupture
  - >40 years
  - previous microtrauma

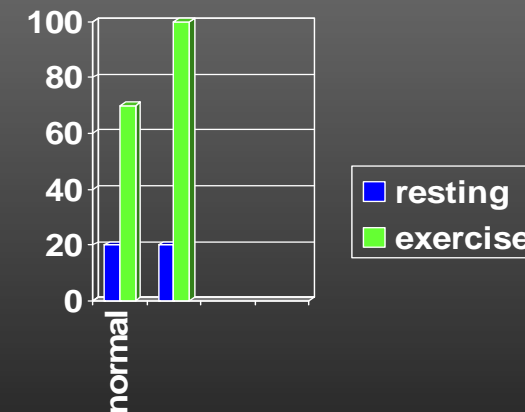


# Lower Leg Injuries

- Four muscle compartments
  - Anterior
  - lateral
  - sup and deep posterior
- Compartment Syndrome
  - fluid accumulation as a result of acute or chronic exertion
  - can affect vascular and neural function
  - Ischemia
  - Fascia adaptations
  - Fasciotomy



Pressure



# Lower Leg Injuries

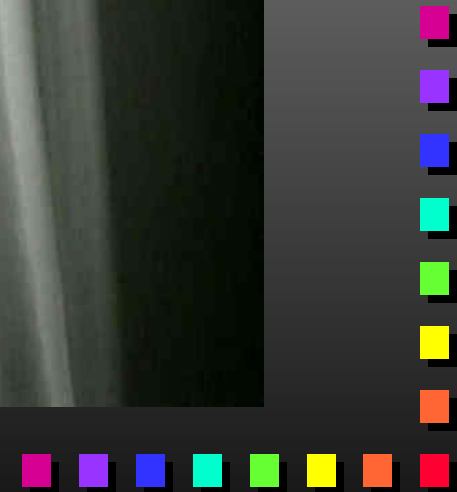
- Tibial stress syndrome:  
Inflammatory reaction of the  
deep fascia
- Mechanism
  - chronic overload
  - can lead to periostitis
  - common in runners
  - multifactor





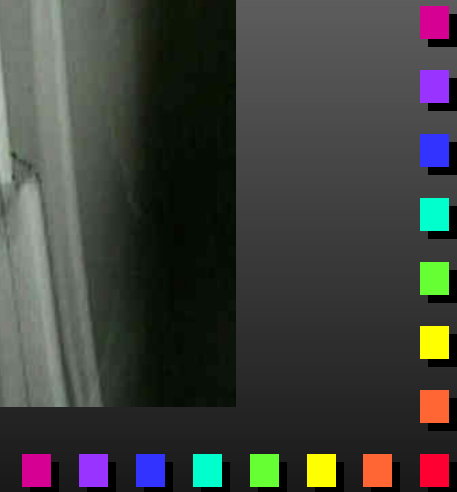
# Lower leg injuries

- Stress reaction: bone with evidence of remodeling but without actual fracture
- Stress fracture
  - 50% occur on the tibia
  - runners: middle and distal third
  - jumpers: proximal fractures
  - dancers midshaft



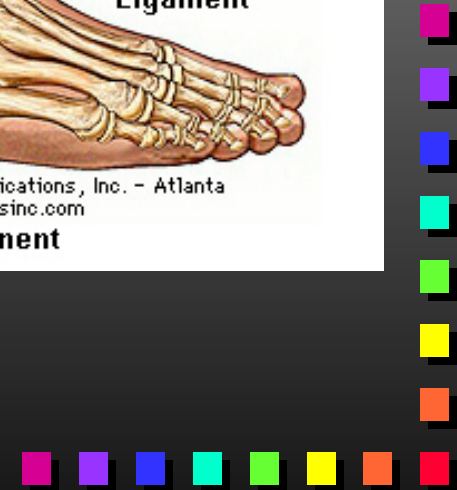
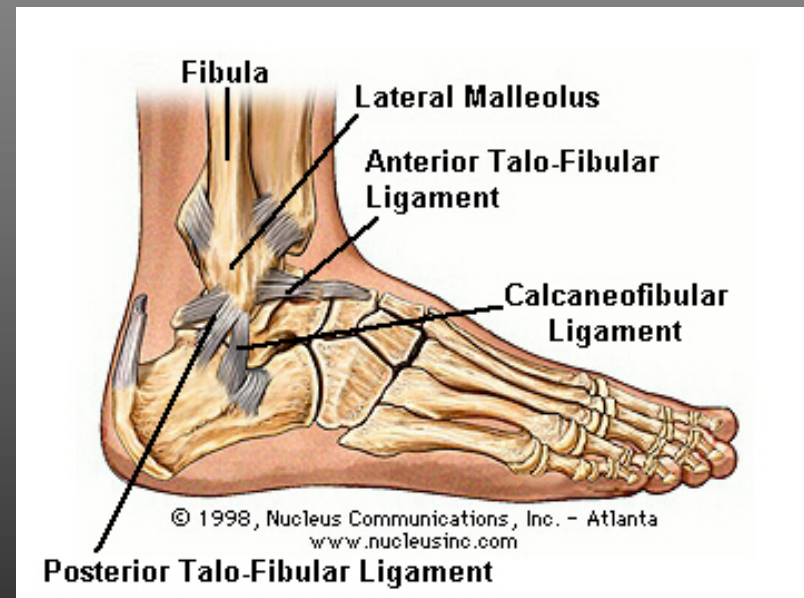
# Lower leg injuries

- High energy fractures
  - car accidents: direct impact
  - skiing: torsional and boot fractures
  - Baseball bats



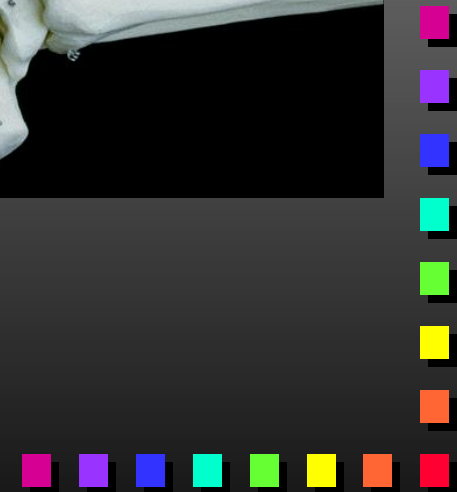
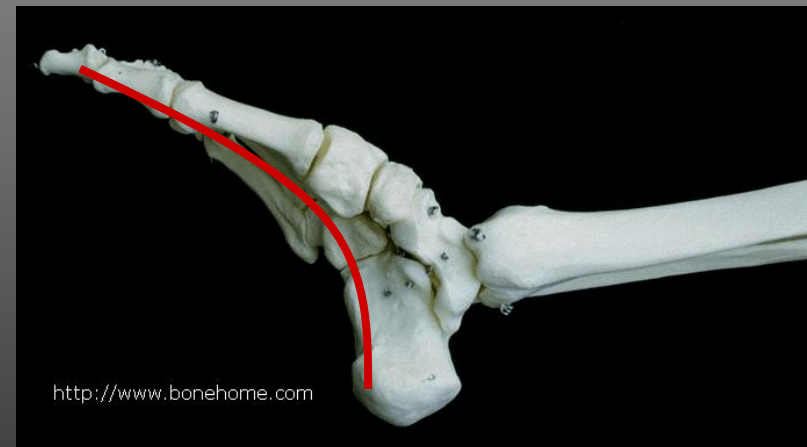
# Foot & Ankle injuries

- Most complex areas in the human body due to large number of muscle, ligaments and bones
- Ligaments
  - deltoid: eversion
  - ATFL: restrict inversion
  - CFL
  - PTFL
- 26 bones
- Achilles tendon



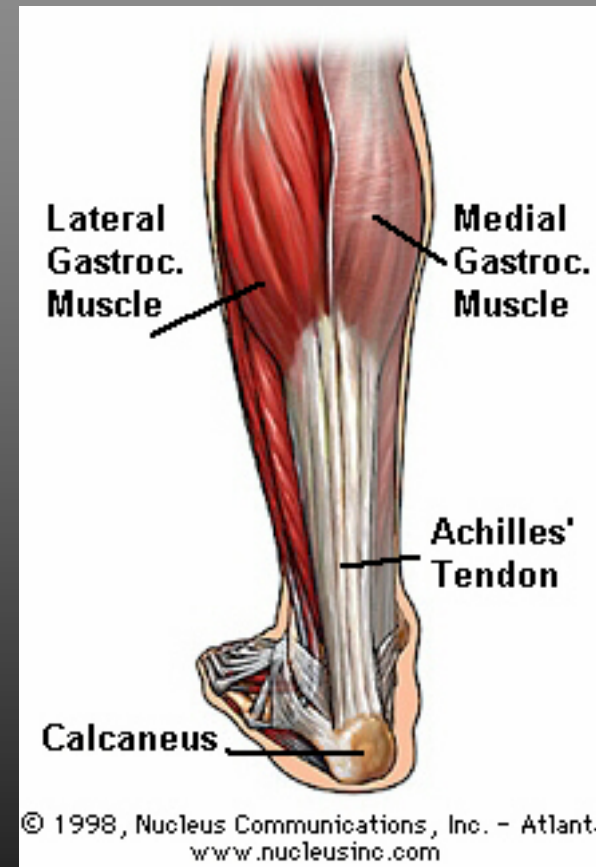
# Foot & Ankle injuries

- Arches
  - Longitudinal
    - medial
    - lateral
  - Transverse
- Absorb and distribute loads during weight bearing
- Supported by bones, muscles, plantar ligaments and plantar fascia



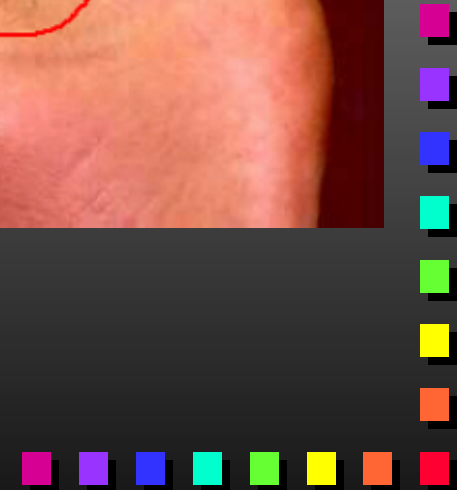
# Foot & Ankle injuries

- Achilles tendon: largest and stronger
  - forces = 10 times BW
- Injuries
  - peritenitis
  - bursitis
  - multifactorial etiology
    - training
    - malalignments
    - trauma
    - footwear



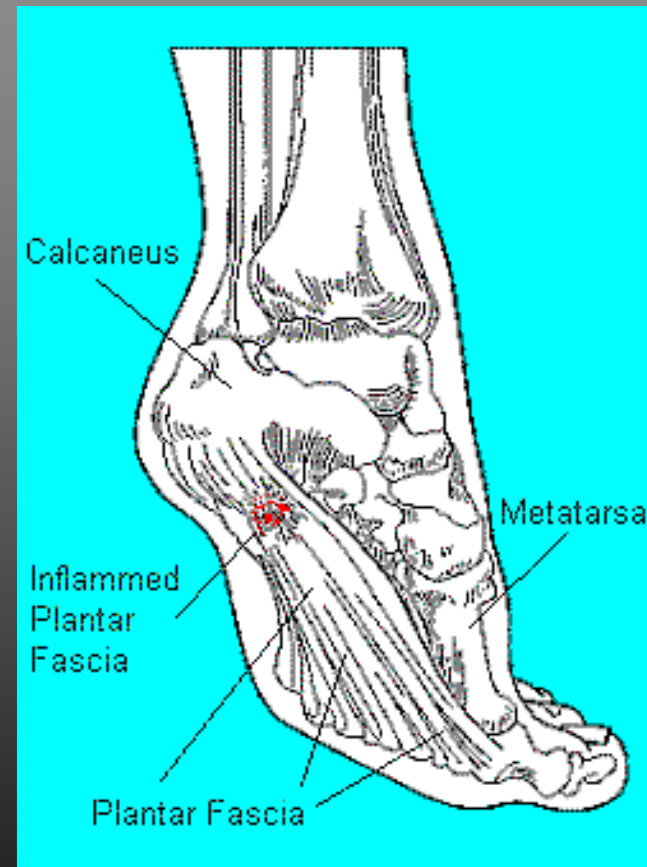
# Foot & Ankle injuries

- Tendon rupture
  - degeneration
  - Men 30-40 years
  - Blood type (O)
- Mechanism
  - sudden dorsiflexion
  - rapid change in direction
  - excess tension on taut tendon
  - taut tendon struck by object



# Foot & Ankle injuries

- Plantar Fasciitis: inflammation of the plantar fascia involving microtears or partial rupture of the fascia
- Repetitive loading compressing the plantar fascia (1.3- 2.9 BW)
- Factors
  - lack of flexibility
  - lack of ankle strength
  - overtraining
  - poor mechanics
  - leg length discrepancies
  - over pronation



# Foot & Ankle injuries

- Ankle sprains: most common injuries
- Irregular talus & stability
  - plantar flexion: unstable
- Involve ankle and subtalar joint
- 85% inversion sprain (supination sprains)
  - ATFL-CFL-PTFL
  - Sometime deltoid (taut in plantar flexion)





# Foot & Ankle injuries

- Eversion sprains (pronation)  
less common
- Fractures malleolus
- Deltoid ligament
- Tibia and fibula separation  
(high forces)



# Foot & Ankle injuries

- Lisfranc
  - Low energy: tripping or bumping
  - High: falls, crashes, object drop
  - Axial loading foot in extreme plantar flexion or dorsiflexion
  - Violent twisting
- Turf toe
  - damage to capsule and ligaments of 1st MP joint

