Orthopedic Concerns in Runners

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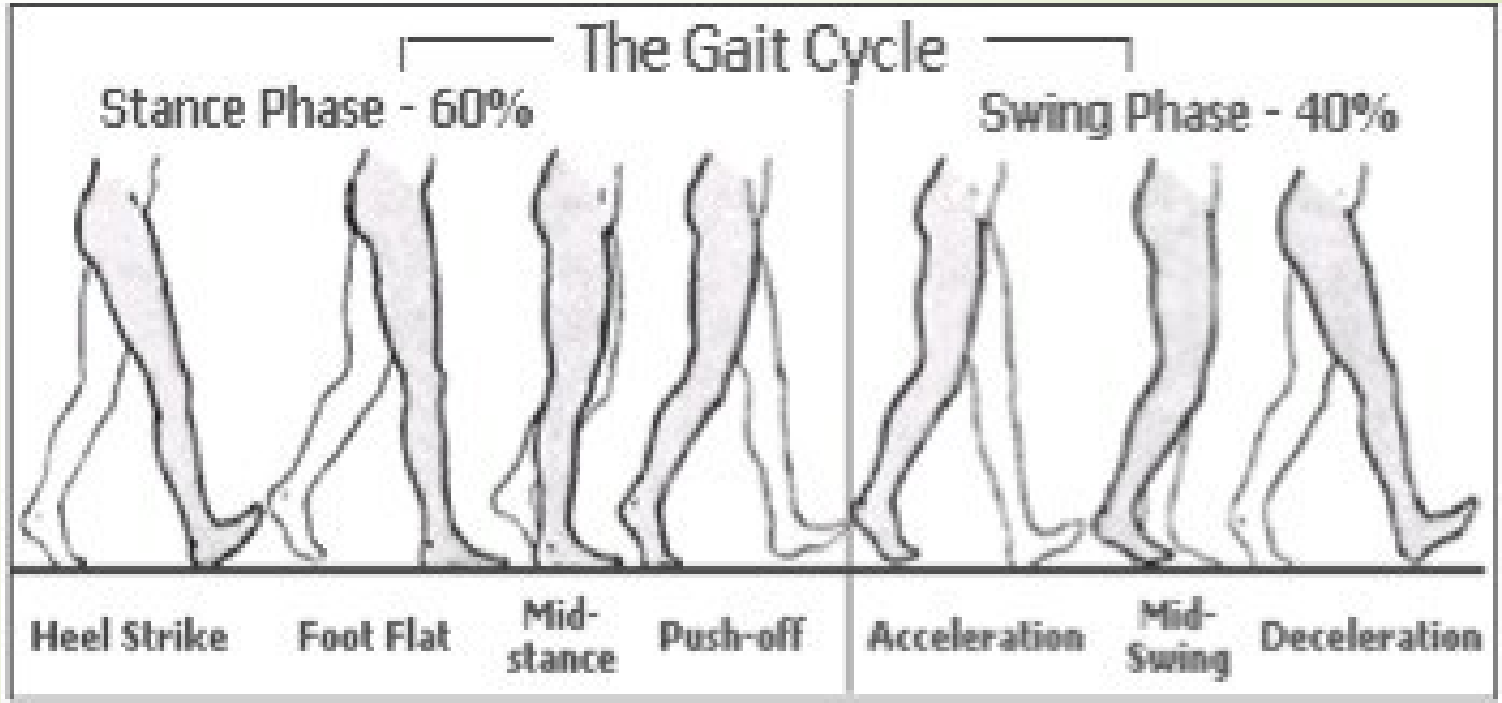
Disclosure

I have no relevant financial relationships or affiliations with commercial interested to disclose.

Learning Objectives

- Discuss differences in walking and running gait
- Identify the most common injuries in runners
- Discuss rehabilitation recommendations for these injuries
- Identify training recommendations for runners
- Discuss barefoot running

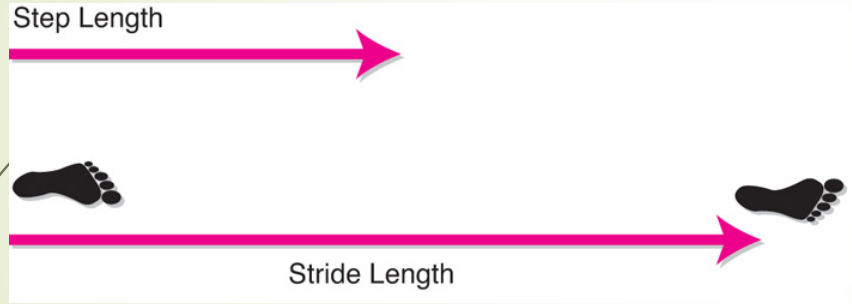
Gait Review


The Gait Cycle
Stance Phase - 60%
Swing Phase - 40%
Heel Strike
Foot Flat
Mid-stance
Push-off
Acceleration
Mid-Swing
Deceleration

Gait Terminology

- Cadence — number of steps taken per unit time (i.e., steps per minute)
- Adults average = 107 +/– 2.7 steps per minute
- Velocity — distance covered per unit time (i.e., m/sec)
- Gait velocity — meters per second
- Gait cadence — steps per minute

Gait Terminology



- Stride time — time required to complete a single stride
- Stride length — linear distance covered in one stride

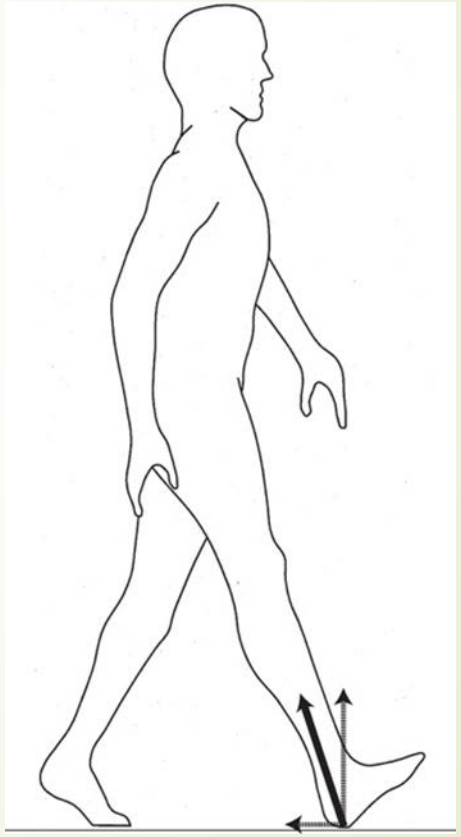
Gait Terminology

Ground reaction force (GRF)

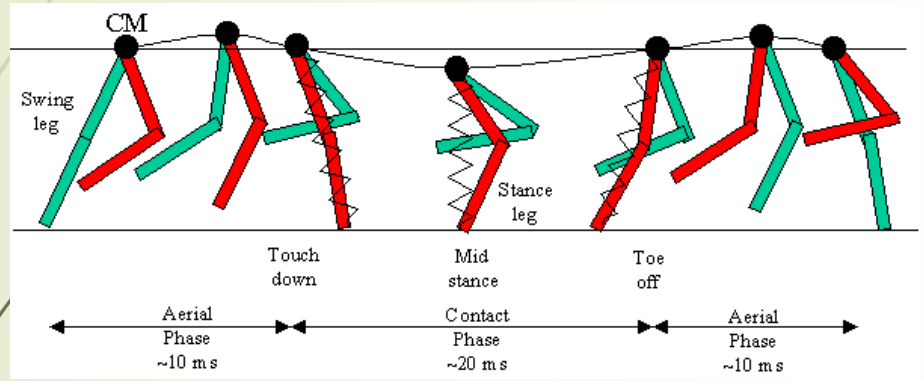
- Contact of the foot with the ground creates force yielding vertical, anteroposterior (A/P), and mediolateral (M/L) components

Center of pressure (CoP)

- Shows the path of the pressure point under the foot during gait

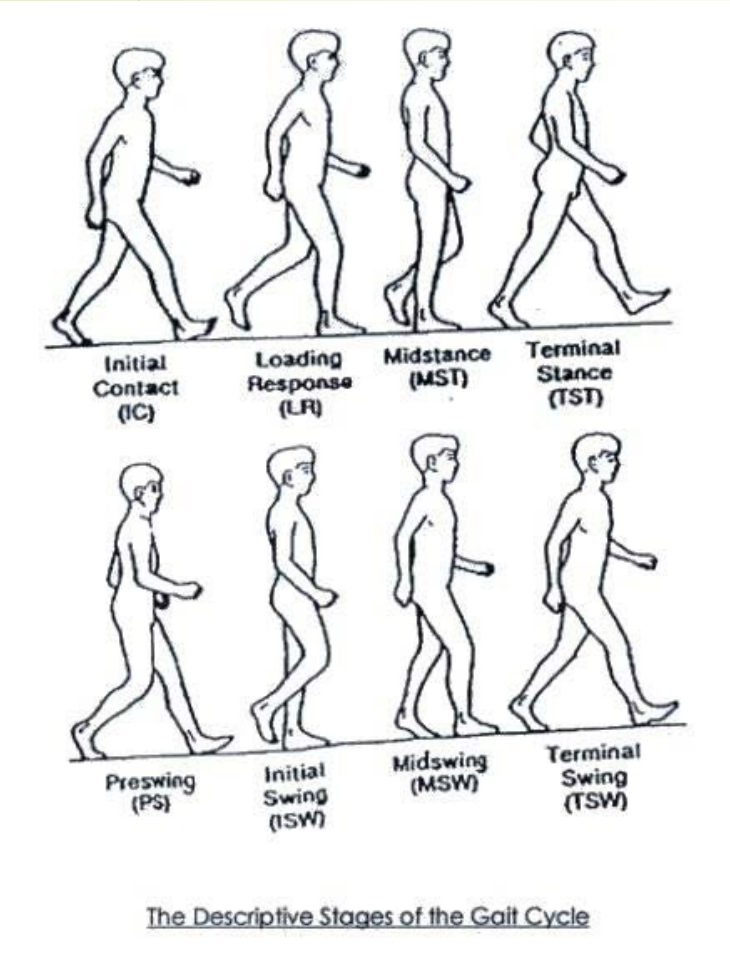


Walking Gait Phases



- Efficient gait
  - Minimal side-to-side motion
  - Maximal forward motion
  - Body rises and falls approx. 5 cm
- Center of gravity
  - Path is a sinusoidal curve

8 Phases of Gait



The Descriptive Stages of the Gait Cycle

- Weight Acceptance
  - Initial Contact
  - Loading Response
- Single Limb Support
  - Mid Stance
  - Terminal Stance
- Limb Advancement
  - Pre-Swing
  - Initial Swing
  - Mid Swing
  - Terminal Swing

Running Gait Cycle

Differences from walking gait

- Flight phase — neither foot is in contact with a supportive surface
- No period of double limb support
- Vertical GRF
  - ↑ 2.0 – 6.0 x the body weight
  - ↓ Stance phase time

- As speed increases there are changes in
  - Arm swing
  - Stride length
  - Cadence
  - Knee flexion ROM
  - Muscular force
  - Speed of contraction
  - Less up and down motion

What Leads to Running Injuries?

Injury Rates

- 27-70% of recreation and competitive distances runners experience at least 1 injury per calendar year[1,4,6,7]
  - Knee most common 42%
    - Patellofemoral
  - Foot, ankle, low leg 40%

Predictors

- Previous history[4,9,10,15,17]
- Lack of experience[4,18]
  - Too much too soon[1]
- Distance[1,4,9,10,15,17]
  - More than 40 miles per week[10]
- Intensity[1,4]
- Frequency[17]
- Shoes/speed/surface[8,10]
- Gender
  - Men: BMI[4]
  - Women: Hip IROT, Navicular Drop, Q angle[4,5,17]

Anatomical and Biomechanical Causes

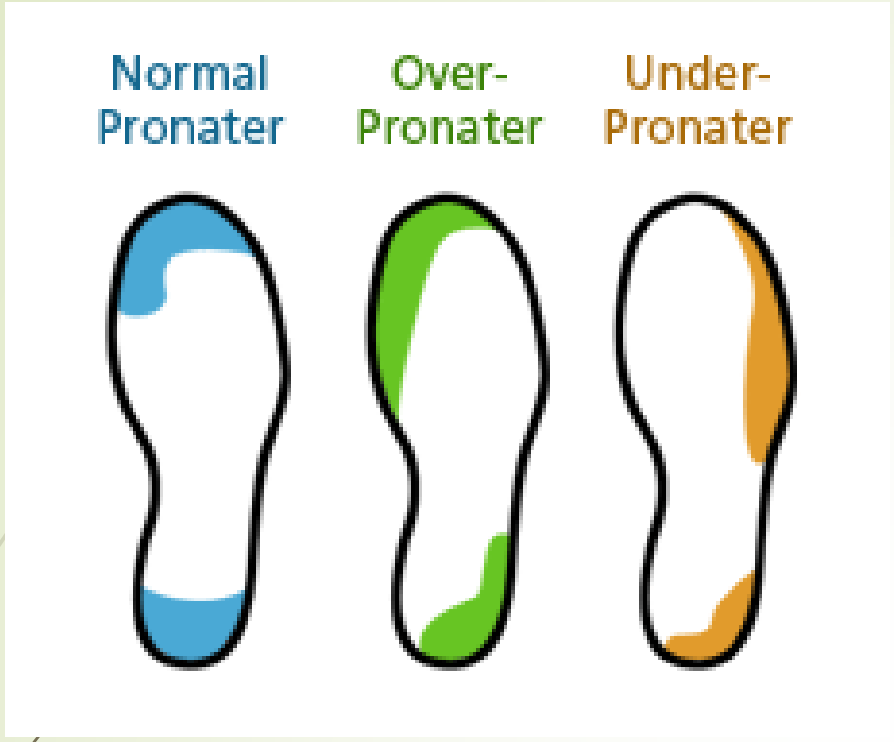
- Foot Posture[6,10]
- Hip Strength[6,8,9]
- Q Angle[5,6,9]
- Hip IROT[5,6,9]
- Genu Valgum[5,6,9]
- Leg Length[8,10]
- Kinematics[8]

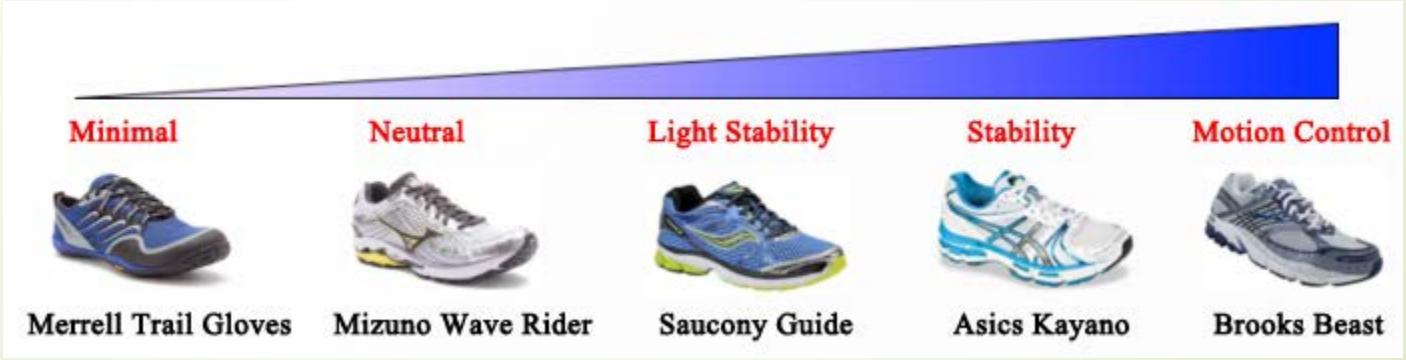
Influence of Foot Structure on Pathology

- Pes planus
  - “Flat feet”
  - Talus tilts medially
  - Navicular displaces inferiorly

Influence of Foot structure on pathology

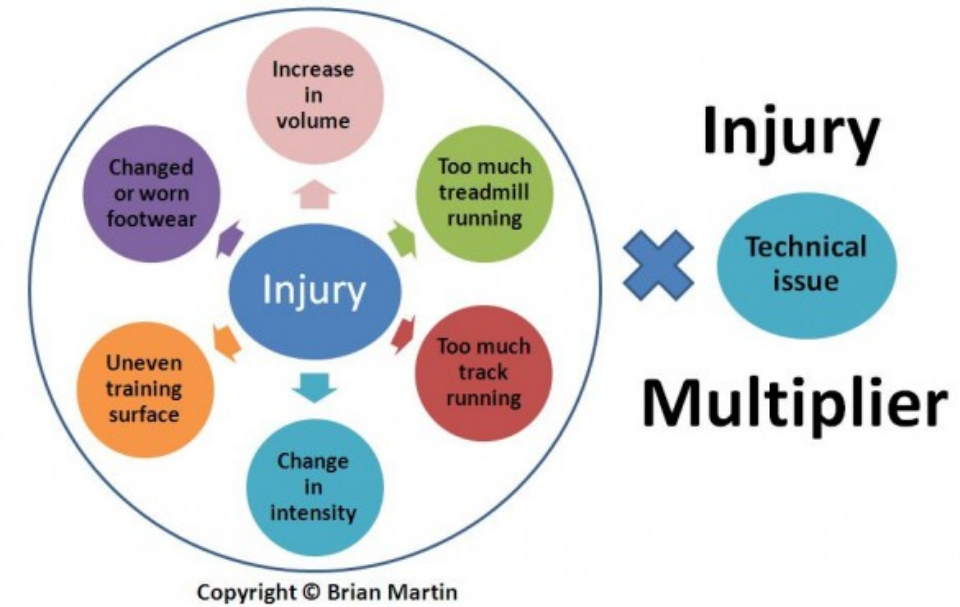
- Pes cavus
  - High medial longitudinal arch
  - Decreased ground contact area
  - Calluses formation over the PIP joints
  - Soft orthotics


Normal Pronater
Over-Pronater
Under-Pronater


Minimal
Neutral
Light Stability
Stability
Motion Control
Merrell Trail Gloves
Mizuno Wave Rider
Saucony Guide
Asics Kayano
Brooks Beast

Common Training Errors

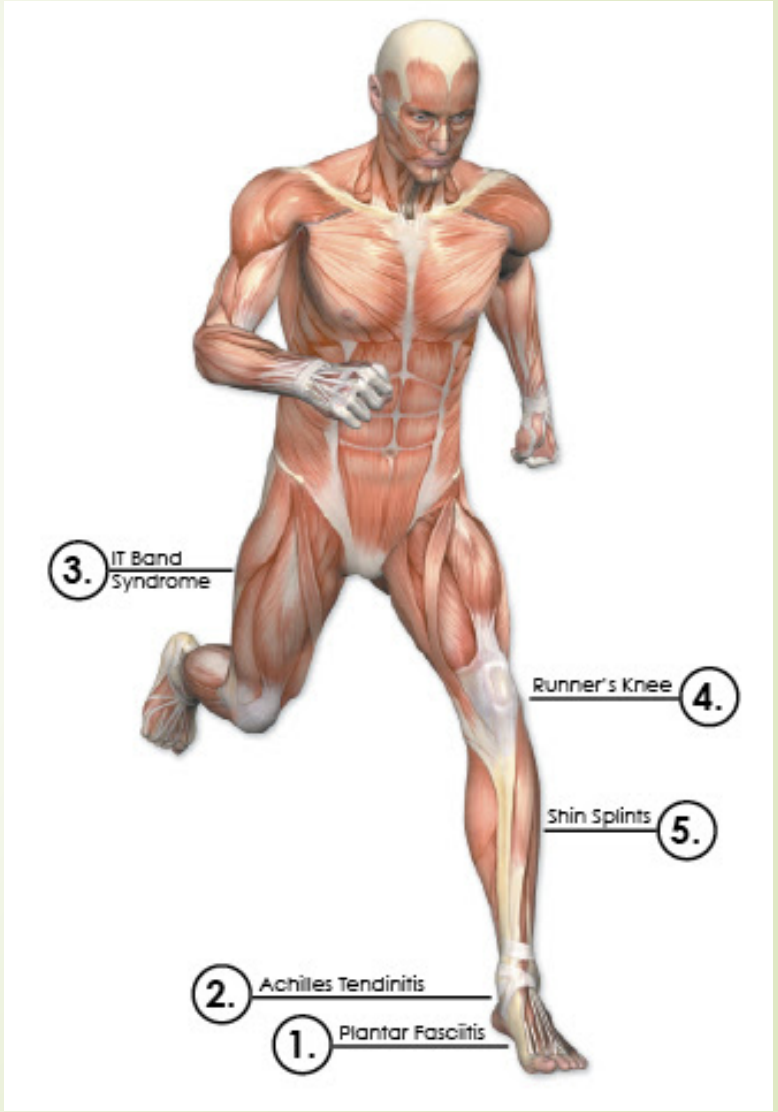
- 60% of injuries due to training errors[1,10]
- 60% related to distance and intensity[2,15]
  - More than 2 long runs per week[9]
- Surface[2]



Common Injuries and Rehabilitation Interventions

Most Common Injuries[1,5,6,7,8,10]

- Patellofemoral Pain Syndrome
- Stress Fractures
- Medial Tibial Stress Syndrome
- Patella Tendonitis
- Plantar Fasciitis
- Achilles Tendonitis
- IT Band Syndrome



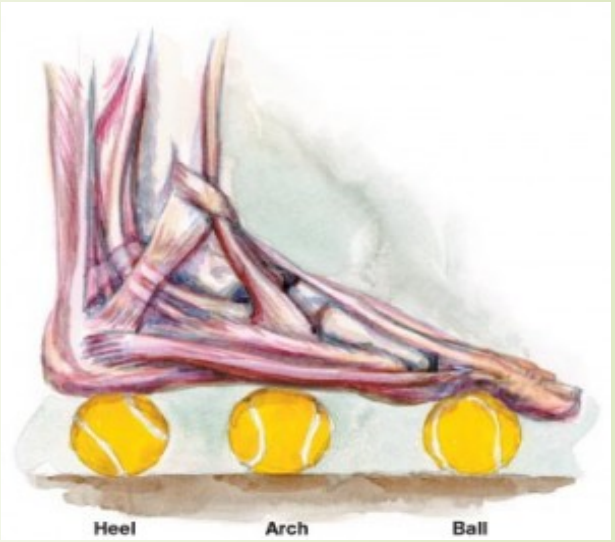
Plantar Fasciitis

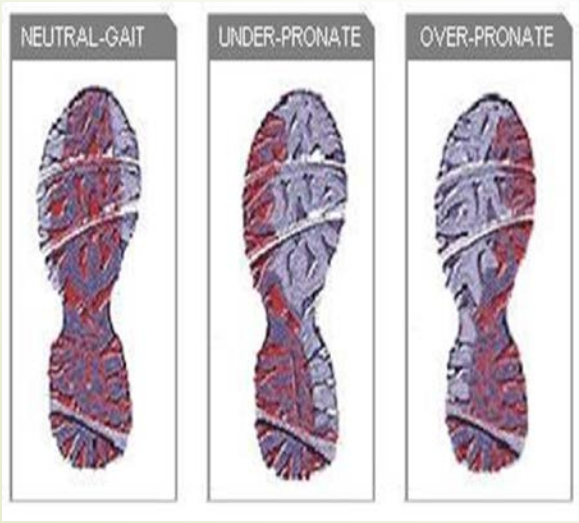
- Inflammatory or degenerative
  - Fasciosis: the noninflammatory degeneration of fascia
- Many causes
- Signs and symptoms
  - Pain on medial calcaneal tubercle
  - Pain when stepping out of bed in the morning
  - Pain in heel after activity

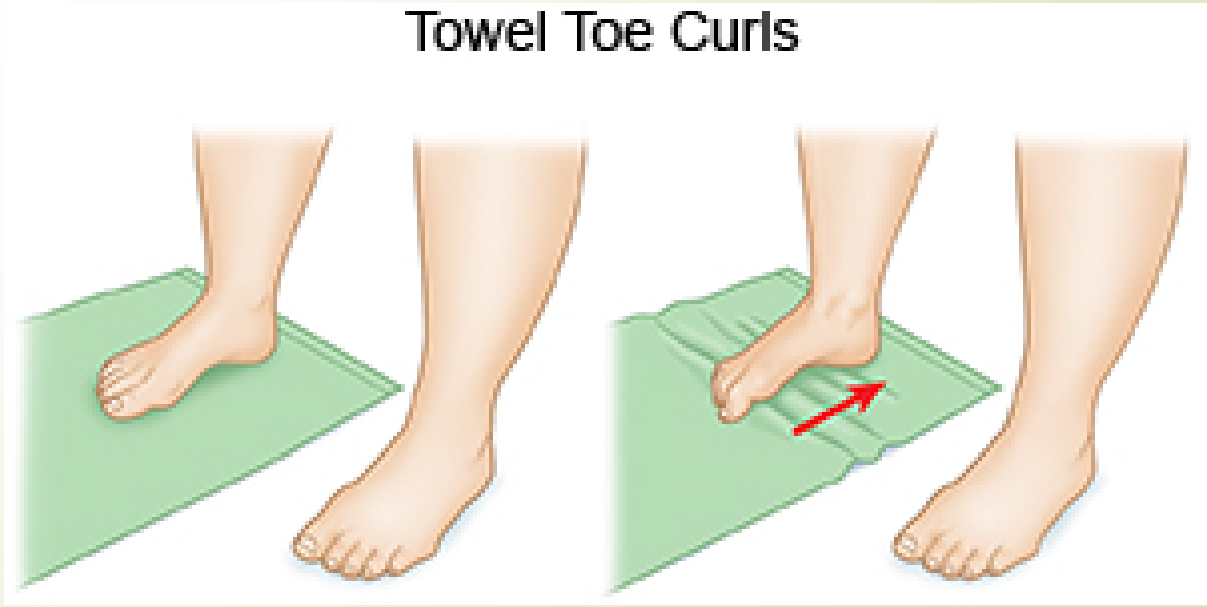
- Plantar fascia rupture
  - MOI: forced ankle DF and toe extension
- Signs and symptoms
  - Difficulty WB
  - “Tearing” sensation
  - Swelling around medial calcaneal tubercle
  - Acute hammer toe

Plantar Faciitis Rehabilitation Suggestions

- Evaluate shoes
- Consider orthotics
- Roll on ball or frozen water ball
- Calf stretching (knee straight and flexed)
- Toes crunches







Stress Fracture

Evaluation

- Accumulation of microtraumatic forces
- Pain increases with activity and decreases with rest
- Pain at night
- Can occur at the tibia, fibula and talus
- Special Tests:
  - Bone scan

Rehabilitation

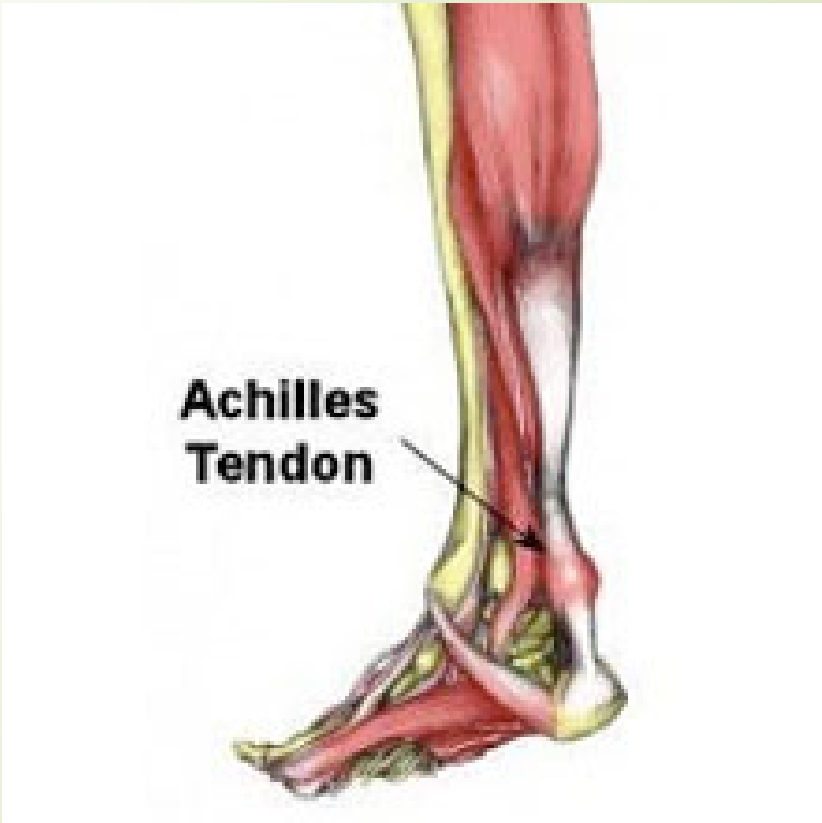
- REST
- Cross Train
- Consider underlying physiological factors
  - Menstrual status
  - Dietary status

Achilles Tendon Strain or Rupture

- MOI
  - DF and eccentric contraction
  - PF and concentric contraction
- Signs and Symptoms
  - Dependent upon severity
  - 3rd degree loud pop and deformity
- Special Tests
  - Thompson test
  - Inability to perform calf raise

Rehabilitation of Achilles Pathologies

- STRETCHING!!!
- Look at the heel counter of shoe for rubbing
- Cross friction massage
- Strengthen calf



Compartment Syndrome

Evaluation

- Acute or chronic
  - Chronic call occur in all 4 compartments
  - Anterior and lateral typically occur together
- MOI:
  - Excessive exercise performed Signs and Symptoms
  - Extreme pain
  - Muscle is hard like bone
  - Paine and pressure felt during exercise
  - Glossy skin
- Special Test
  - Pressure gauge

Intervention

- Surgical fasciotomy
- Orthotics

Medial Tibial Stress Syndrome

Evaluation

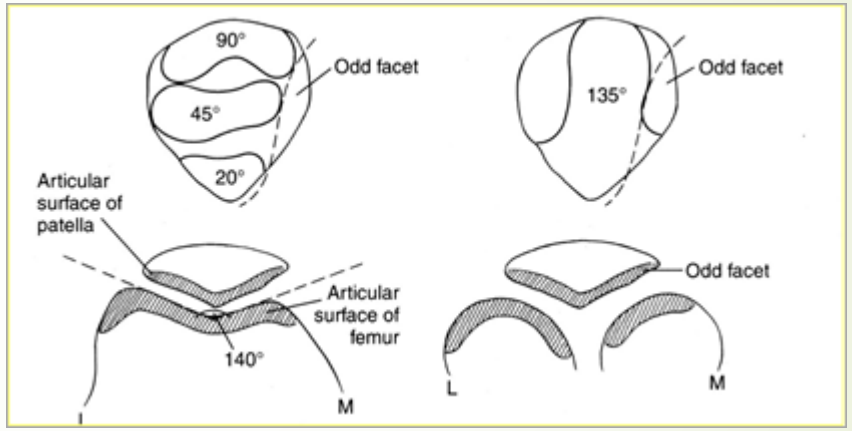
- Periostitis at the posterior border of the tibia
- Caused by:
  - Repetitive use
  - Training errors
    - Increasing load too quickly
    - Muscle fatigue
  - Incorrect shoes
  - Biomechanical abnormalities

Intervention

- Shoes/orthotics
- Soft tissue along medial tibial border and posterior tibialis origin
- Strenghening

Contributors to Patellofemoral pain[3,6]

- Contralateral hip drop
- IROT of femur
- Valgus knee
- IROT of tibia
- Foot pronation



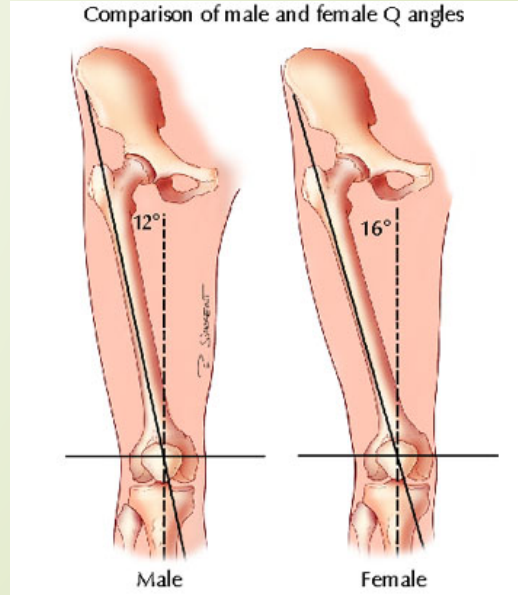
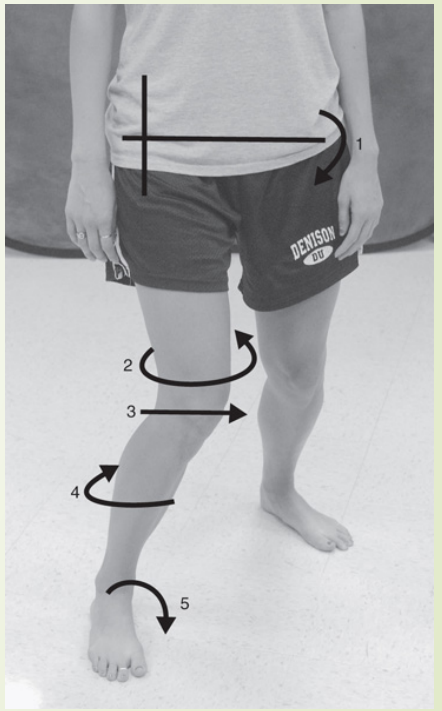


Table 11–3. Structural Abnormalities and Their Resultant Forces and Biomechanical Changes	
Alignment	**Resulting Forces and Biomechanical Changes**
Genu varum	Increased compressive forces on the medial tibiofemoral articulating surfaces
	Tensile forces on the lateral tibiofemoral soft tissue structures and LCL
	Quadriceps exerting medially directed forces on the patella
	Compressive forces on the lateral facet
	Stretching of the lateral patellar restraints
Genu valgum	Increased compressive forces on the lateral tibiofemoral articulating surfaces
	Tensile forces on the medial tibiofemoral ligaments
	Quadriceps exerting laterally directed forces on the patella
	Compressive forces on the odd and medial facets
	Stretching of the medial patellar restraints
Increased Q angle or lax medial restraints	Lateral tracking of the patella
	Compressive forces on the lateral facet
	Stretching of the medial patellar restraints
Decreased Q angle or lax lateral restraints	Medial tracking of the patella
	Compressive forces on odd and medial facets
	Stretching of the lateral patellar restraints
Genu recurvatum	Decreased compressive forces in terminal knee extension

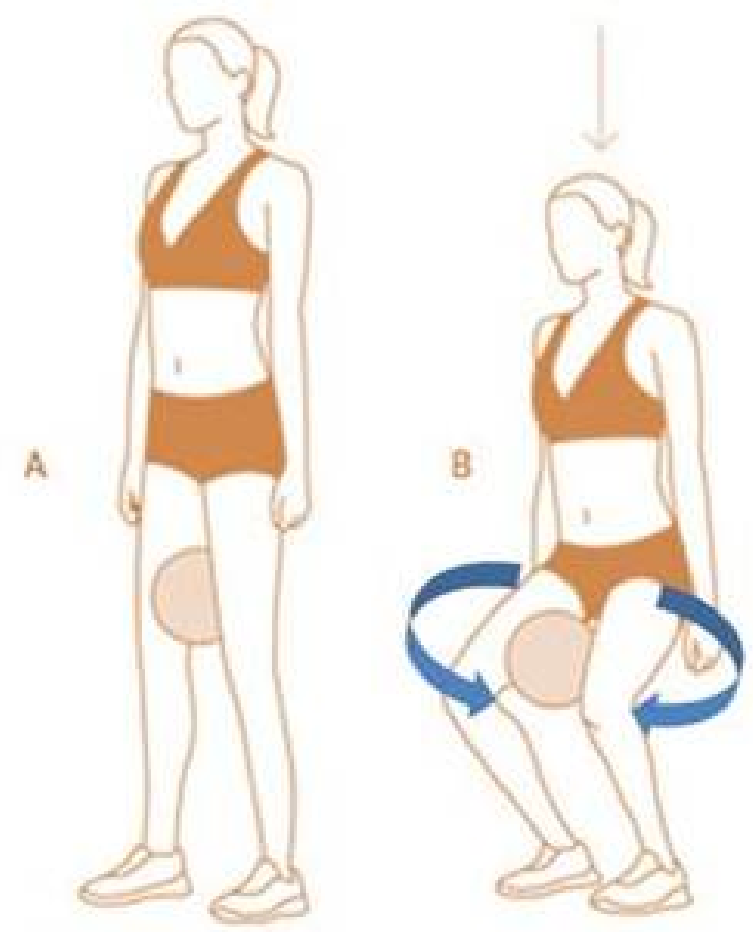


Patellofemoral Pain Syndrome

- MOI
  - Gradual onset due to change in surface, activity level, or intensity.
  - Change in footwear
- Signs and Symptoms
  - Increased Q angle, patella alta, baja
  - Think hip and foot predispositions
  - Pain at medial knee and facets
- Special Tests:
  - Ober's
  - Navicular drop

Interventions for PFPS

- Strengthen VMO
- Eccentric training
- Stretching
- Bolstered knee brace
- Shoes/orthotics



Patellar Tendinopathys

- MOI
  - Repeated knee extension
  - Increase in activity
  - jumping
- Signs and Symptoms
  - Crepitus
  - Inflammation on either end of patella tendon
  - Swelling
  - Thickening of the tendon
- Rehabilitation
  - Cho Pat/Patella Tendon Strap
  - Eccentric strengthening

IT Band Friction Syndrome

- Friction between the IT band and lateral femoral epicondyle
- Repeated knee flexion sports
- Management
  - Correct biomechanical issues
  - Decrease inflammation
  - Proprioceptive exercises
  - Strengthening exercises

- MOI:
  - Repeated knee flexion and extension
- Signs and Symptoms:
  - Pain over lateral femoral condyle
  - Pain increased with running downhill
  - Genu varum
  - Excessive pronation
  - Leg-length discrepancy
- Special Tests:
  - Ober's
  - Noble's

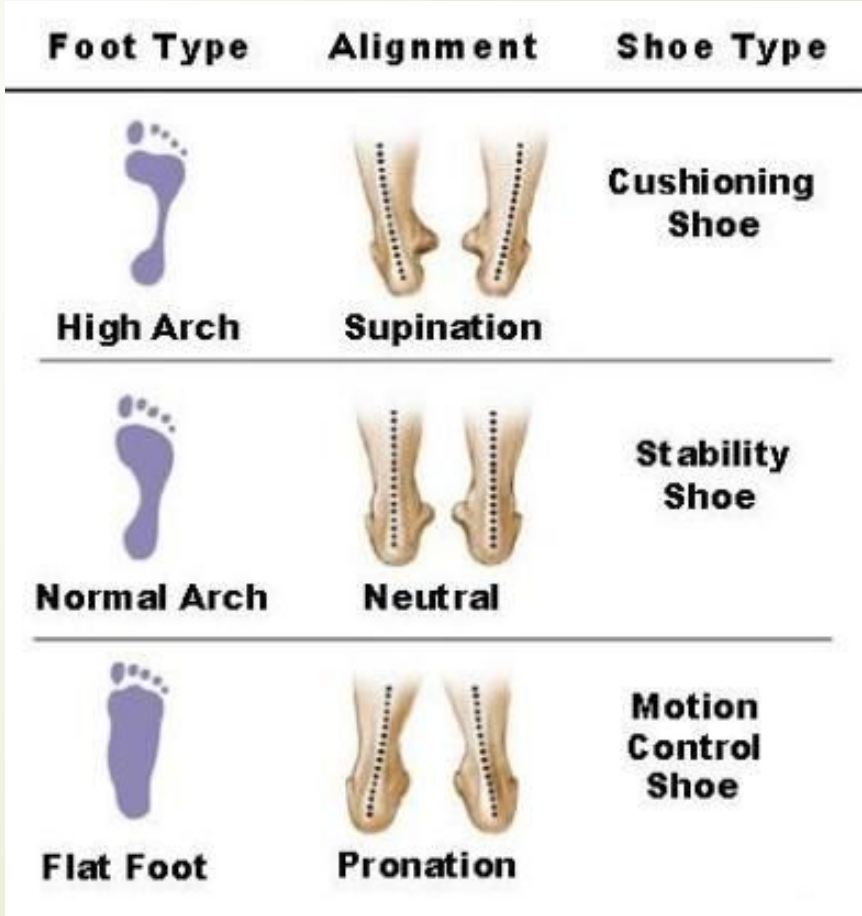
Rehabilitation of IT Band Syndrome

- Stretching
- Foam Roller
- ID biomechanical issues
- Cross training

Training Recommendations

Shoes

- Critical to reduce injuries[1,10]
- Replace every 300-430 miles[2]
- Neutral to stability for hyper pronators[11]



Orthotics

- 70% of patients response positively to orthotics[2]
- Prevent stress fractures[10]
- Breaking in process is ESSENTIAL

Distance/Intensity

- Less than 40 miles per week[10,12]
- Novice should should run no more than 45 minutes per outing[12]
- 8 week training protocol has been demonstrated to be most effective[12]

Frequency

- 2-5 runs per week[12]
- 24-48 hours of rest between runs[2]
- Increasing step rate can decrease patellofemoral forces by 14%[14]

Surface

- Key is cross training between surfaces[2]
- Running Routine
- Those with PFPS and MTSS should avoid hard surfaces[2]
- Those with PFPS and ITBS should avoid hills[2]

Cross Training

- Strengthening[2,10]
  - Eccentric quadriceps
  - Hip abduction (gluteus medius)
- Plyometrics increase performance[16]

How Does a Novice Runner Begin??

- Use the 10% Rule[3,12]
  - Initial goal should be run 30 minutes
  - Then to run 2 miles non-stop regardless of time
  - Most novice running programs run 5-8 weeks
    - No noted differences between 8 and 13 week programs[12]
- Start no more than 3 times per week running/walking
- Stretch afterwards
- Cross Train
- REST!

Novice Walk-Run Program[2]

Table 1. Sample walk-run program: *The walk-run program is started after a patient has demonstrated the ability to walk 30 minutes consecutively without injury 3 times weekly on alternate days. The goal is to run pain-free for 30 minutes 3 times weekly. It involves a total activity period of 30 minutes structured into six sets of 5 minutes on alternate days. In each set, there is a combination of running and walking where the run component is increased after each session by 30 seconds.*

WEEK	MONDAY	WEDNESDAY	FRIDAY
1	10-min walk	20-min walk	30-min walk
2	6x (4.5-min walk + 0.5-min run)	6x (4-min walk + 1-min run)	6x (3.5-min walk + 1.5-min run)
3	6x (3-min walk + 2-min run)	6x (2.5-min walk + 2.5-min run)	6x (2-min walk + 3-min run)
4	6x (1.5-min walk + 3.5-min run)	6x (1-min walk + 4-min run)	6x (0.5-min walk + 4.5-min run)
5	30-min run	30-min run	30-min run

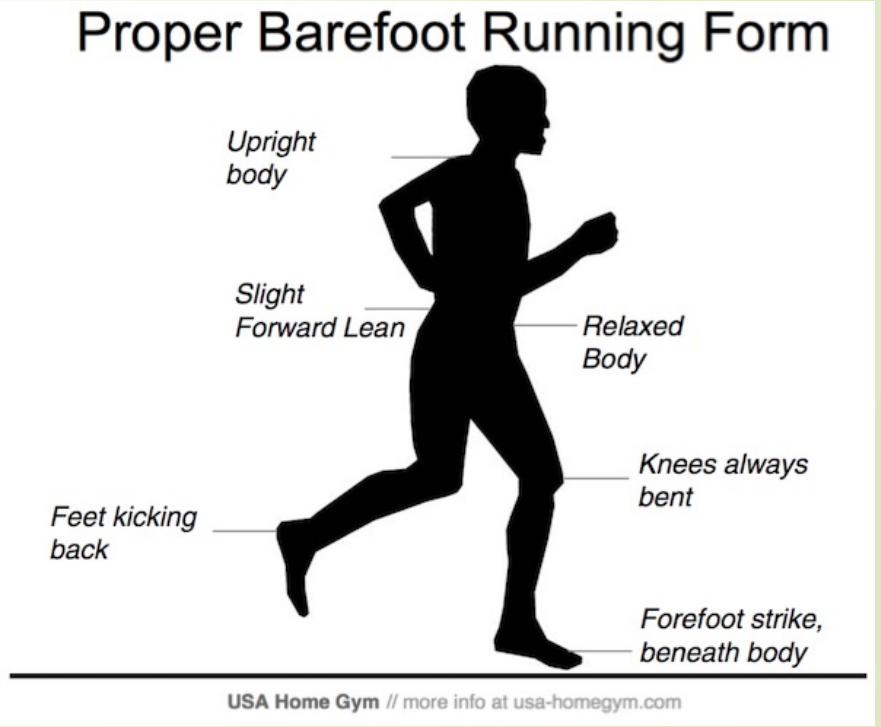
What about Barefoot Running????

Barefoot Running

- High tech running shoes didn't appear until 1970
- Shod = heavy heel strike
- Barefoot = midfoot or forefoot strike

Barefoot Running

- Shorten Stride[10]
  - Decreases risk of stress fractures
- Increase step count
  - 600 strikes/KM[13]



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