

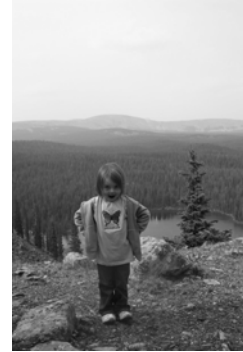
## Mechanical Force and Injury

- Forces are inevitable and often helpful, yet can also cause injury; typically magnitude is first considered
- Others factors should also be considered
  - Stress
  - Point of Application
  - Direction of Application
  - Loading Rate
  - Frequency of Application

## Mechanical Force and Injury

### Force versus Stress

–\$100 dare...



## Bare Feet vs Golf Spikes

Shoe Surface Area = 97 cm<sup>2</sup>

Surface Area of 12 Golf Spikes = 0.36 cm<sup>2</sup>

Syd weighs ~156 N

Calculate the stress with bare feet (97 cm<sup>2</sup>), in comparison to the stress with the golf spikes (0.36 cm<sup>2</sup>), and you will see that the area of force application is often as, or more, important force magnitude

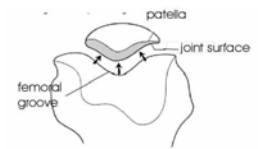
## Mechanical Force and Injury

### • Force versus Stress

– Achilles tendon force versus stress...

2800 N of force vs 72.7 MPa of stress

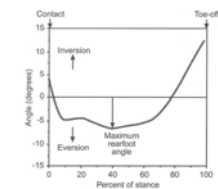
– Patella-femoral joint pain...



## Mechanical Force and Injury

### Point of Force Application

- Hyperpronation...
- Inversion or eversion...



## Mechanical Force and Injury

### Direction of Force Application (compression, tension, shear, and/or torsion)

- Shear forces upon the tibia...
- Shoulder impingement...

What biological tissue characteristic is this related to?

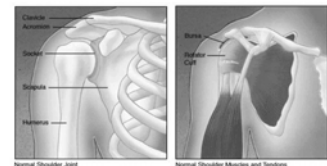
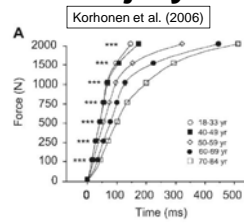


Figure 1: Normal anatomy of the shoulder

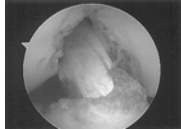
## Mechanical Force and Injury

### Loading Rate

- ACL rupture...
- Landing techniques...
- Landing techniques and bone development



What biological tissue characteristic is this related to?



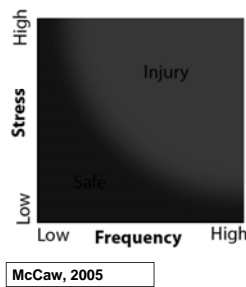
## Tissue Response to Stress

- How do tissues respond to stress?  
With mechanical stress, tissue grows (this is similar to Wolff's Law)
- Can anyone think of any specific previously discussed examples?
  - bony prominences—e.g., tibial tuberosity
  - trabecular patterns
  - muscle response to resistance
  - collagen arrangement in connective tissue

## Frequency/Magnitude of Force

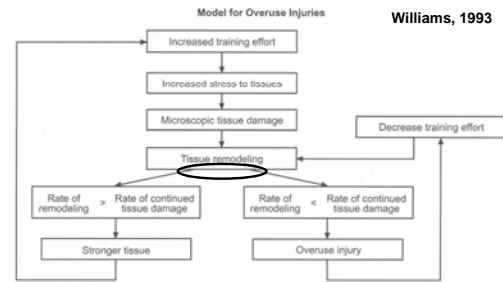
Controlling applied stress frequency is important when training, as many injuries result from a single load

- Baseball pitchers
- Gymnasts
- Football Players
- Runners



## Frequency of Force

Often the time between training sessions determines whether a chronic injury is experienced



## Intrinsic Factors in Injury

- Intrinsic factors involve the individual's capacity to bear load
  - Body mass
  - Skeletal: density, alignment, asymmetry
  - Muscular: strength, endurance, firing patterns, temperature
  - Previous history of injury
  - Psychological: motivation and tolerance for pain

## Extrinsic Factors in Injury

- Extrinsic factors involve the nature of the load that will be imposed on the individual
  - Nature of task: frequency, speed, intensity, and duration
  - Level of participation: opponent, recreation vs. competitive
  - Equipment: footwear, padding
  - Environment: playing surface condition, weather