

Introduction

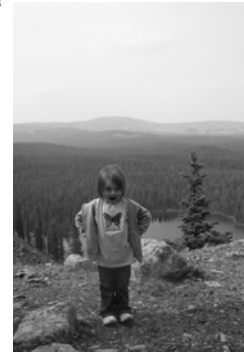
- Force characteristics that are related to injury prevalence:
 - Magnitude, cross-sectional area, location, rate, direction, and frequency of force application
- Factors to consider in injury prevention
 - Frequency and magnitude of force application
 - Recovery time
 - Intrinsic and extrinsic factors

Mechanical Force and Injury

Cross-sectional area

Force versus Stress

–\$100 dare...



Mechanical Force and Injury

Cross-sectional area

Tennis Shoe Surface Area = 97 cm²

Surface Area of 12 Golf Spikes = 0.36 cm²

Syd weighs ~156 N

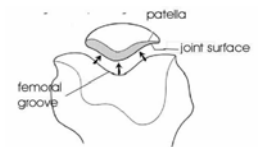


The area of force application is as important than force magnitude

Mechanical Force and Injury

Cross-sectional area

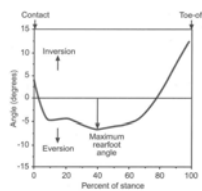
Patella-femoral joint pain and shin guards



Mechanical Force and Injury

Application Location

Hyperpronation



Mechanical Force and Injury

Cross-sectional area

Hyperpronation



Walking gait analysis
Note the toeing in during left foot contact and how he walks on the lateral aspect of the foot

Mechanical Force and Injury Loading Rate

ACL rupture, gymnastics padding, and osteogenesis

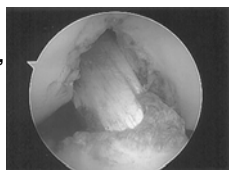


Table 1 Summary Force Characteristics

	Peak 1	Peak 2
Vertical GRF (BW)	5.6 ± 1.4	8.3 ± 2.3
Resultant HRF (BW)	4.7 ± 1.4	5.7 ± 1.9
Avg loading rate (BW/s)	472 ± 168	

Note: GRF = Ground reaction force; HRF = Hip joint reaction force; BW = Body weight

What biological tissue characteristic is this related to?

Bauer et al., 2002

Mechanical Force and Injury Load Direction

Shoulder impingement...

What biological tissue characteristic is this related to?

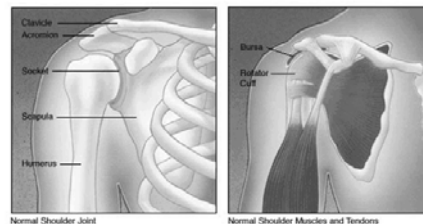
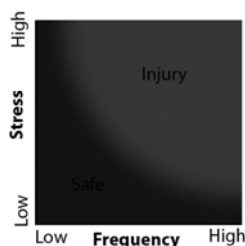


Figure 1. Normal anatomy of the shoulder

Frequency/Magnitude of Force

Controlling the frequency and the magnitude of the applied stress is important when training

- pitchers
- gymnasts
- football players
- runners



McCaw, 2005

Frequency of Force

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



Intrinsic Factors in Injury

- Intrinsic factors that influence injury risk
 - 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 and influence injury risk
 - Nature of task: frequency, speed, intensity, and duration
 - Level of participation: opponent, recreation vs. competitive
 - Equipment: footwear, padding
 - Environment: playing surface condition, weather

Summary

- **Force characteristics that are related to injury prevalence:**
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- **Factors to consider in injury prevention**
 - Frequency and magnitude of force application
 - Recovery time
 - Intrinsic and extrinsic factors