

Biomechanics

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Biomechanics

- **Biomechanics**
 - Branch of Bioengineering and Biomedical Engineering
 - Application of classical mechanics to the analysis of biological and physiological systems
- **Bioengineering and Biomedical Engineering**
 - *Interdisciplinary field in which principles and methods from engineering, basic sciences, and technology are applied to design, test, and manufacture equipment for use in medicine and to understand, define, and solve problems in physiology and biology.*

Biomechanics vs. Kinesiology

- **Biomechanics**

- Application of mechanics to biological systems
- More specific than kinesiology
 - Yet also very broad in its study and application

- **Kinesiology**

- Scientific study of human movement
- Spans anatomical, physiological, psychological, biomechanical areas

Research in Biomechanics

- **Experimental Studies**

- Mechanical properties of biological materials (e.g. bone, cartilage, muscle, tendon, skin, blood)

- **Model Analyses**

- Utilize measured initial conditions to simulate a hazardous effect (e.g. head impact)
- Phenomenological models model the response, to figure out initial conditions (e.g. determine heel pad stiffness based on impact attenuation)
- Theoretical models using experimental data (initial conditions) are used to predict the effect of environmental and operational factors without resorting to lab experiments (e.g. head impact)

- **Applied Research**

- Purpose is predominantly to benefit human function

Biomechanics of the Knee

- **Knee is a 2-joint**
 - structure
 - Tibiofemoral joint
 - Patellofemoral joint
- **Sustains high forces and moments**
- **Situated between the body's 2 longest lever arms**

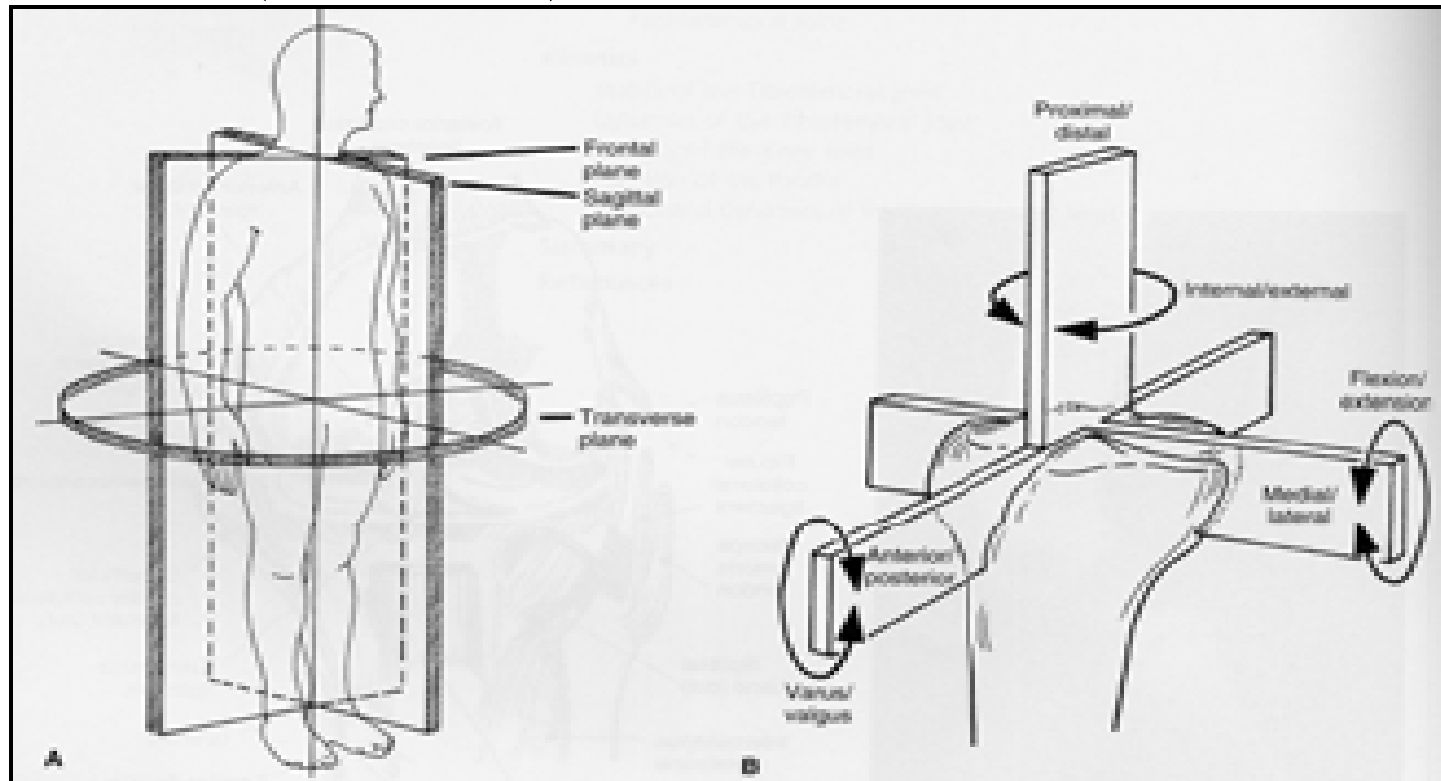


Kinetics

- **Kinetics -- Static and dynamic analysis of forces and moments acting on a joint**
- **Statics – study of forces and moments on a body in equilibrium**
- **Dynamics – study of moments and forces acting on a body in motion**

Kinematics

- Defines the range of motion and describes surface motion of a joint in 3 planes
 - Frontal (coronal or longitudinal)
 - Sagittal
 - Transverse (horizontal)



Statics of tibiofemoral joint

- **Static analyses useful when**
 - **No motion takes place**
 - **At an instant of time during dynamic activity**
- **Complete static analysis**
 - **Highly complicated to analyze all forces and moments in 3-D**
 - **Simplified techniques often utilized**
- **Limit analysis to a single plane**

Dynamics of tibiofemoral joint

- **Steps for calculating minimum magnitudes of forces acting on a joint at an instant of time during dynamic activity**
 - **Identify anatomical structures including point of contact and lever arms**
 - **Determine angular acceleration of moving body**
 - **Determine mass moment of inertia**
 - **Determine torque acting about the joint**
 - **Calculate magnitude of joint reaction force at instant using statics**