

Problem Set
HST 020 Musculoskeletal Pathophysiology
Due Monday January 31, 2006

1. What is the joint reactive force F_j during the single legged stance phase of gait for a female patient who weights 60 kg? Assume that the abductor force F_{AB} from the gluteus medius is a single point force acting at the tip of the greater trochanter, and that the center of hip rotation is at the center of the femoral head. The acceleration of gravity is 9.8 m/s^2 .

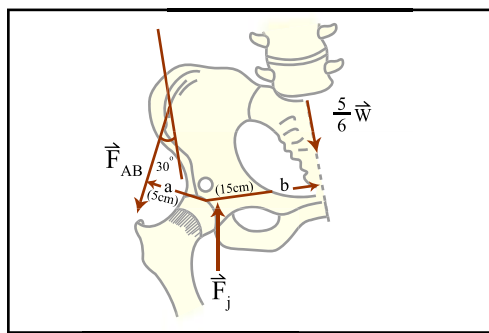


Figure by MIT OCW.

2. Contrast an osteoblast to an osteoclast regarding:

- Origin
- Function
- Cell surface receptors
- Organelles and other structures
- Discuss a disease for each cell type characterized by a specific abnormality of that cell type.

3. Given two patellar tendon grafts which have the same length, but the cross-sectional area of graft A is twice that of graft B, assume that each graft undergoes uniaxial tension at a constant strain rate.

- What is the equation for structural stiffness (k) and for material stiffness or Young's modulus (E)?
- Sketch the force vs. displacement curves for grafts A and B, and sketch stress vs. strain curves for these same grafts.

Assume that the anterior cruciate ligament and the medial collateral ligament have approximately the same cross-sectional area, but the medial collateral ligament is twice the length of the anterior cruciate ligament. Each ligament undergoes uniaxial tension at a constant strain rate.

- Sketch the force vs. displacement curves as well as the stress vs. strain curves for the two ligaments.

4. A common mechanical test used to characterize the material properties of engineering and biological materials is the simple axial compression test. Consider a cylindrical specimen subjected to such a test, and the resulting load-deformation curve sketched below.

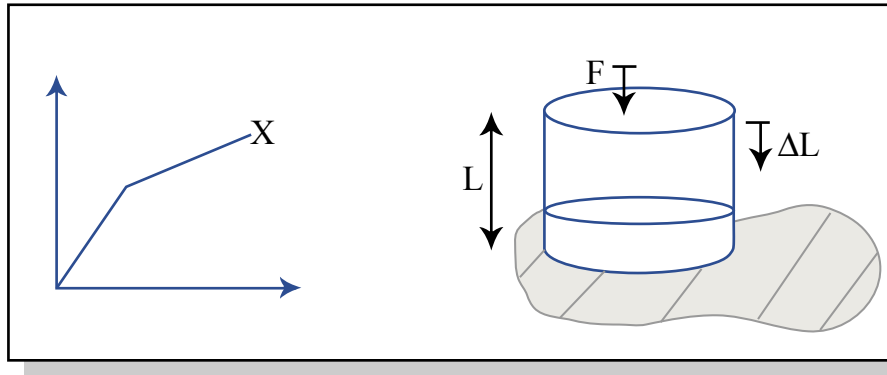


Figure by MIT OCW.

- How is the stiffness (k) of the specimen defined?
- How do increases in area (A) and length (L) affect stiffness (k)?
- How is a stress-strain curve obtained from the force-deflection curve?
- Sketch the stress-strain curve and identify the elastic modulus, yield stress, yield strain, ultimate stress, and ultimate strain. What do each of these terms mean?