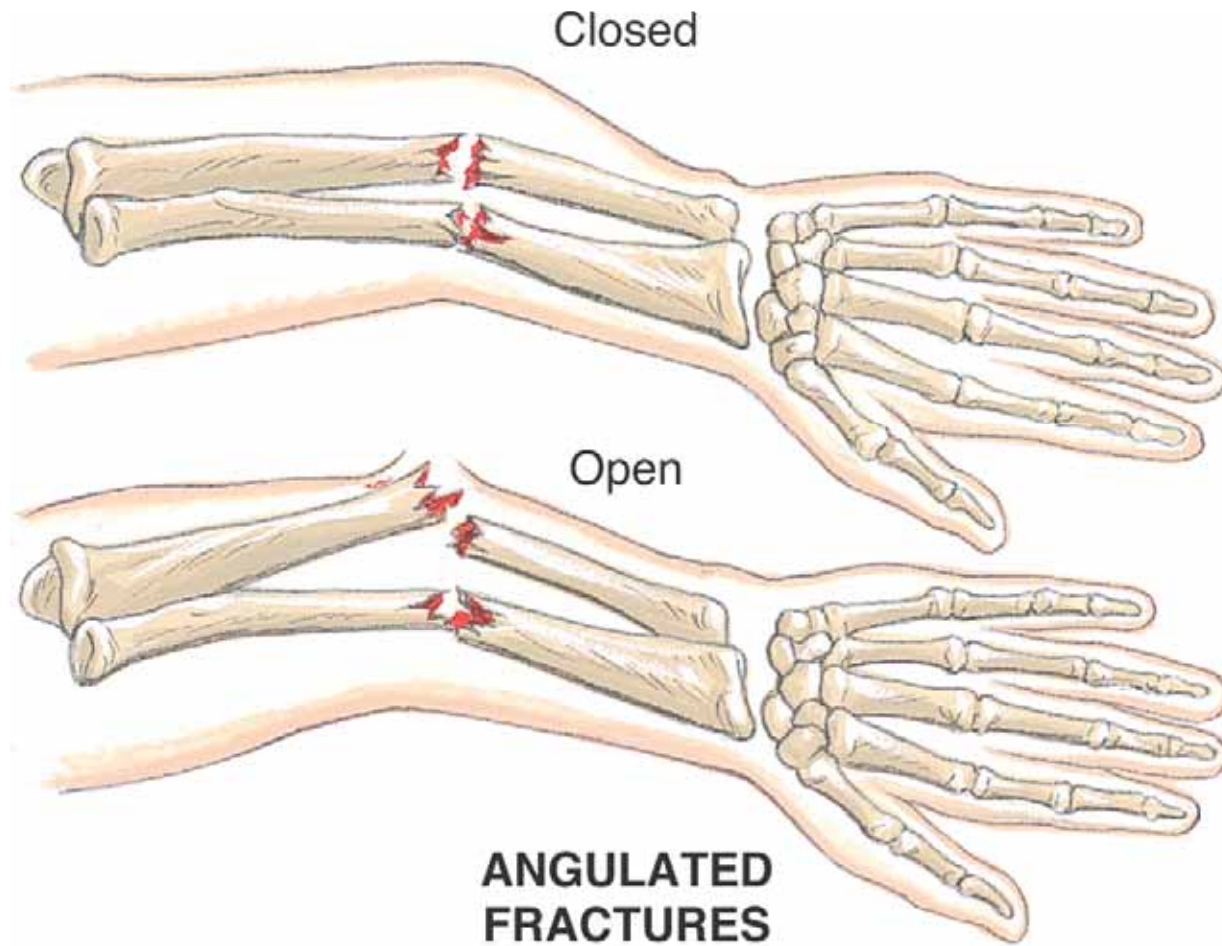
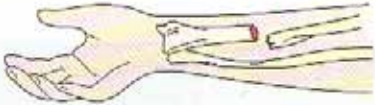

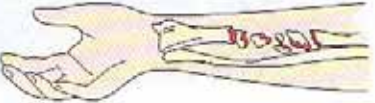
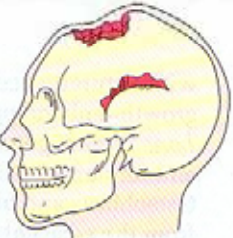
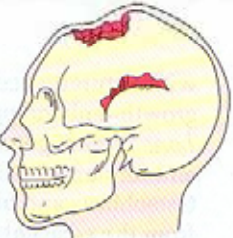
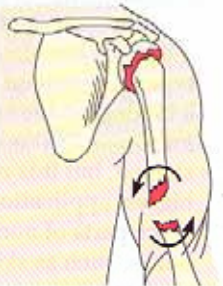
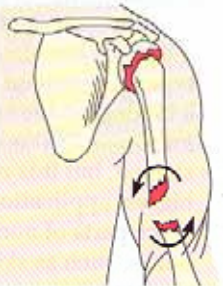



# Section 19: Fracture Mechanics and Breaks

**FIGURE 32-6** Skeletal injuries may be open or closed.

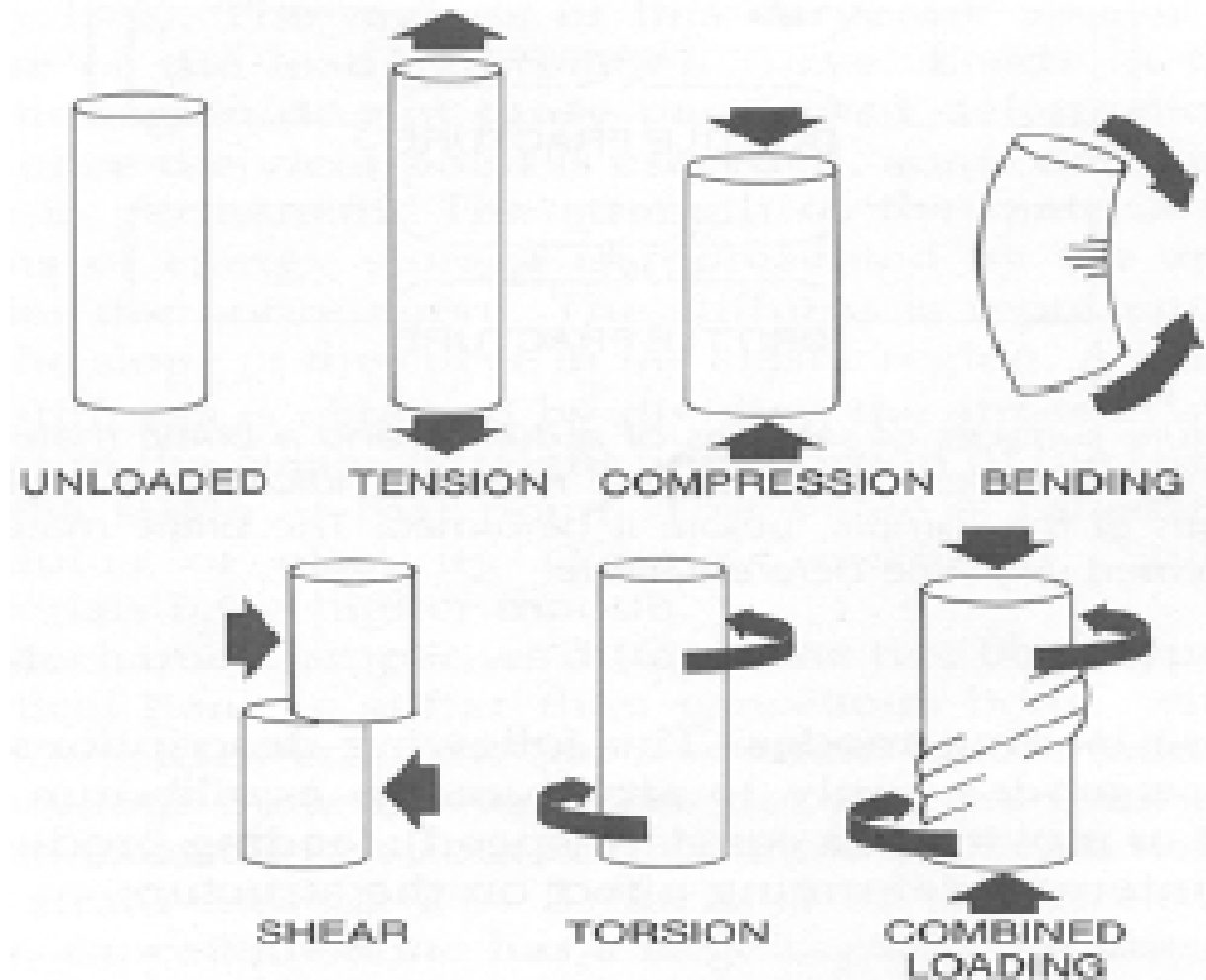


Fracture type	Illustration	Description	Comments
Simple		Bone breaks cleanly, but does not penetrate the skin	Sometimes called a closed fracture
Compound		Broken ends of the bone protrude through soft tissues and the skin	More serious than a simple fracture; may result in a severe bone infection (osteomyelitis), requiring massive doses of antibiotics
Comminuted		Bone fragments into many pieces	Particularly common in the aged, whose bones are more brittle
Compression		Bone is crushed	Common in porous bones (i.e., osteoporotic bones)
Depressed		Broken bone portion is pressed inward	Typical of skull fracture
Impacted		Broken bone ends are forced into each other	Commonly occurs when one falls and attempts to break the fall with outstretched arms; also common in hip fractures
Spiral		Ragged break occurs when excessive twisting forces are applied to a bone	Common sports fracture
Greenstick		Bone breaks incompletely, much in the way a green twig breaks	Common in children, whose bones have relatively more organic matrix and are more flexible than those of adults

# Fundamental Mechanical Loads

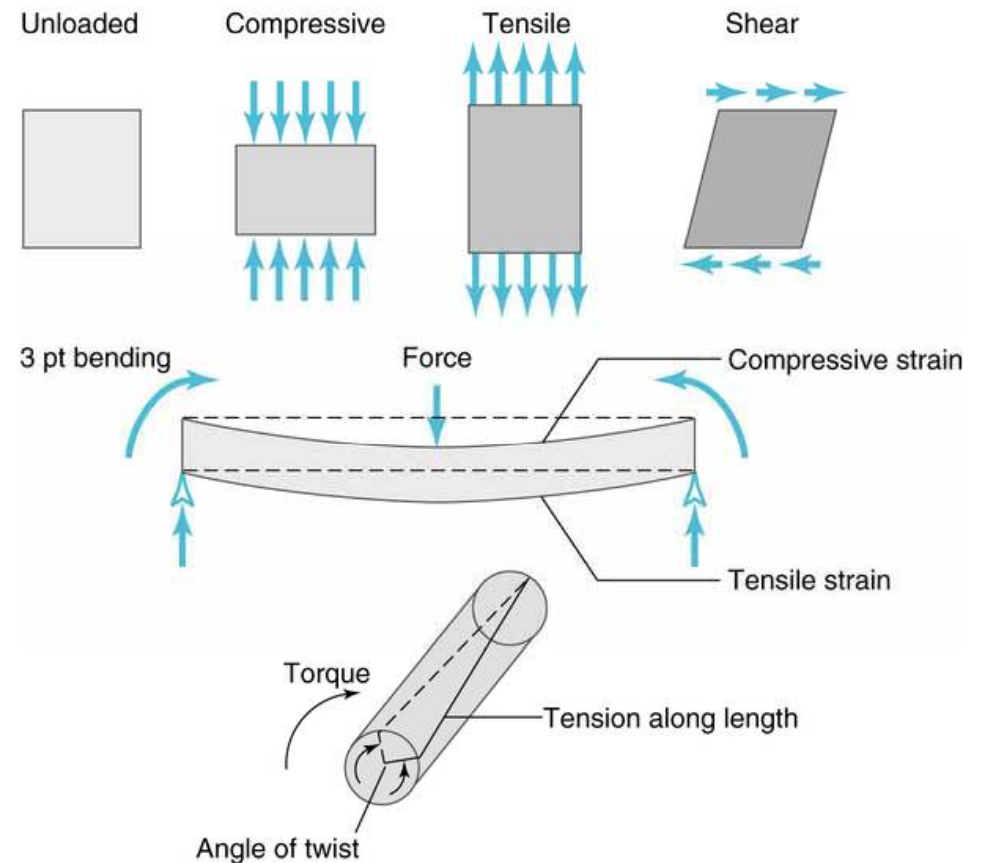
How might your bones be loaded in each of these ways?

What forces would you expect your bones to respond to best/worst?

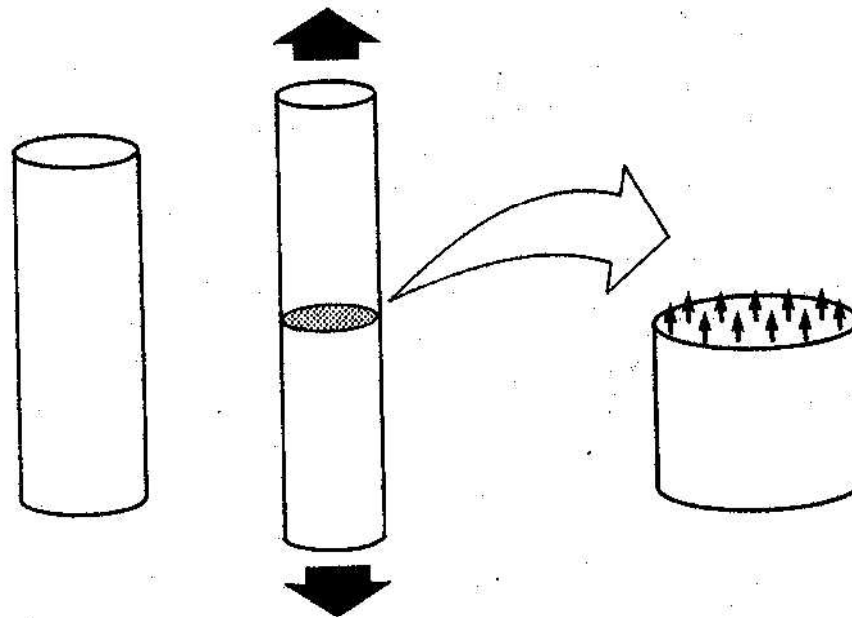


# Basic Forces Causing Fracture

- Compression
- Tension
- Transverse Loading
- Torsion

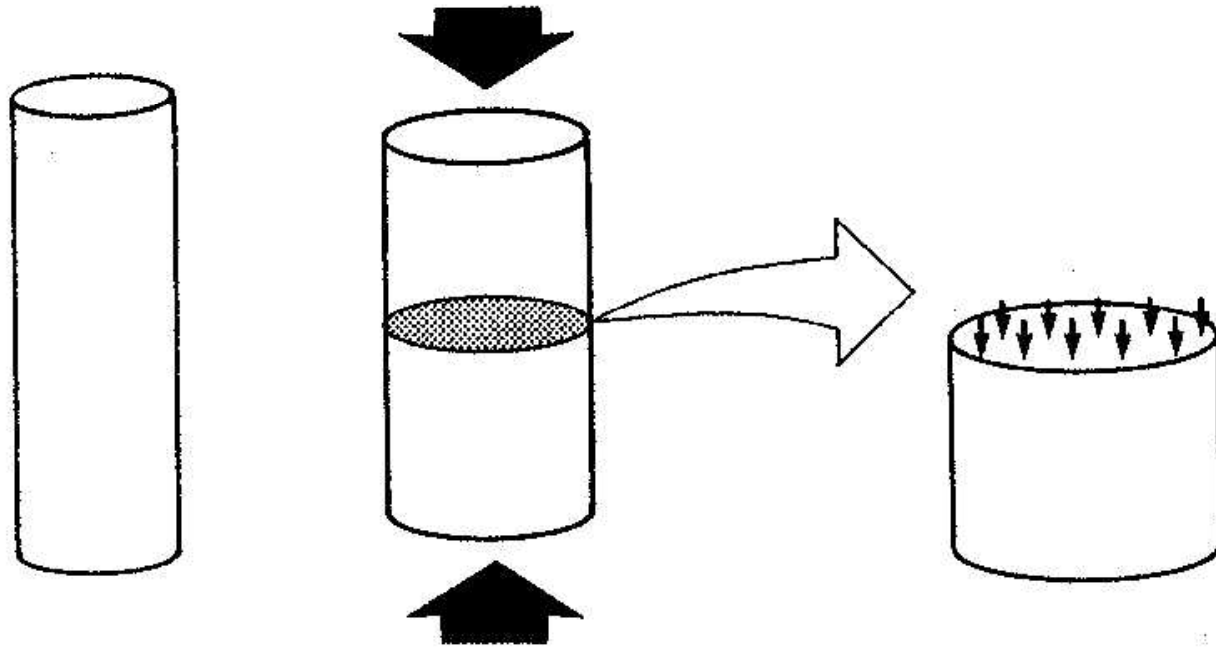


# Tensile Loading



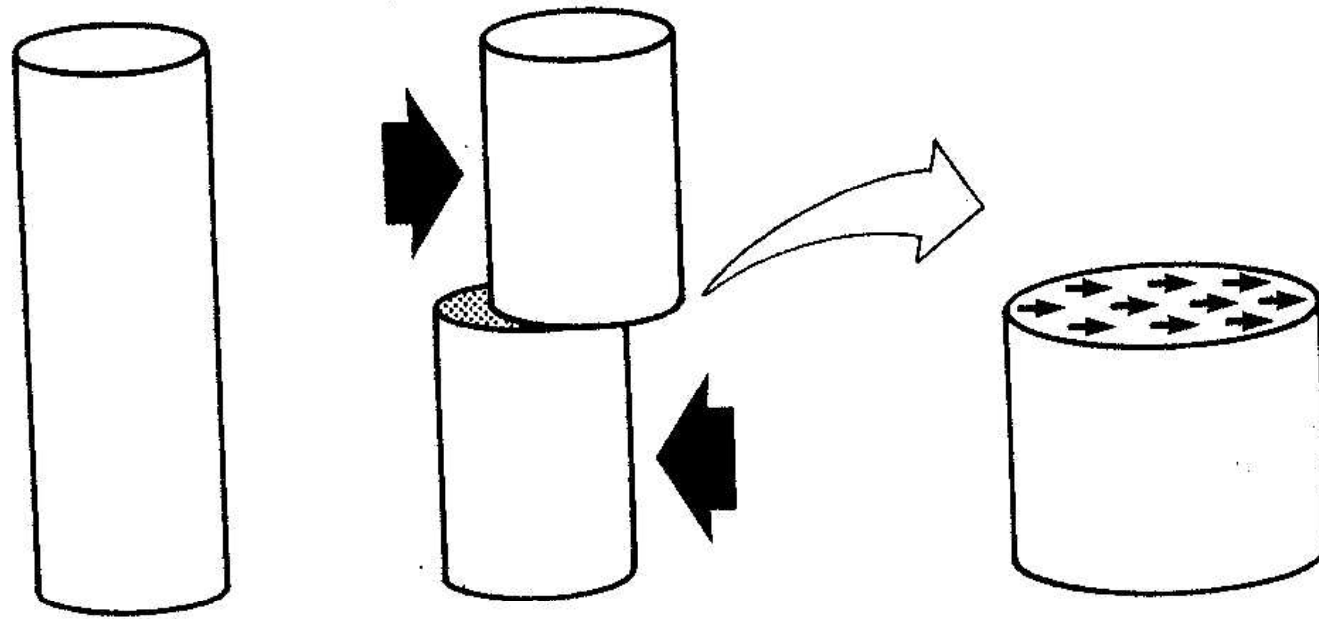
Tensile loading.

# Compression Loading



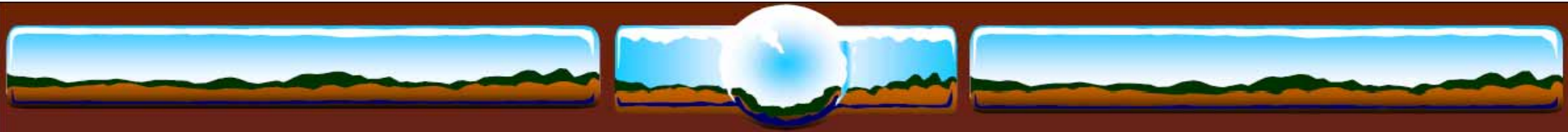
Compressive loading.

# Shear Loading

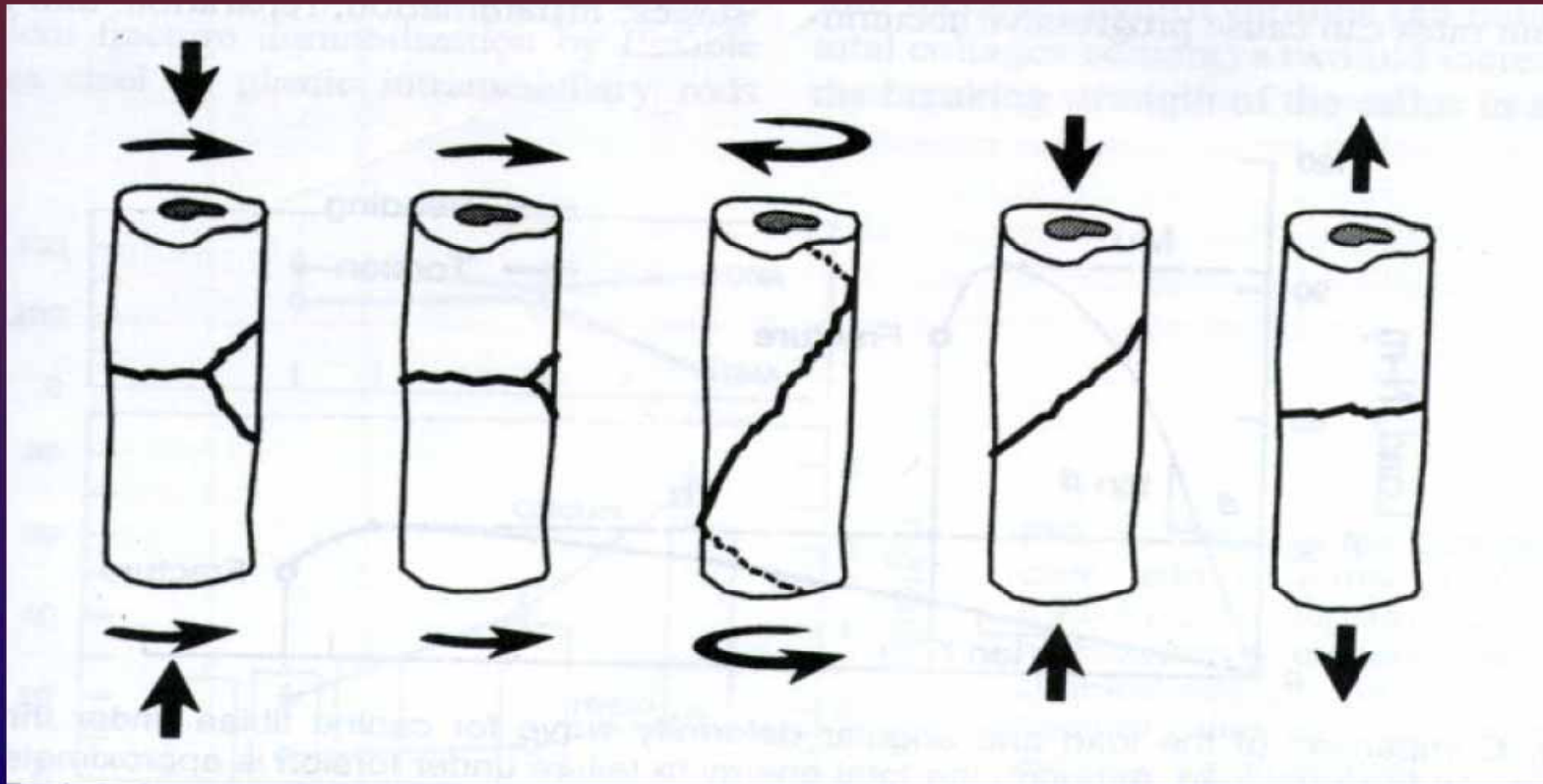


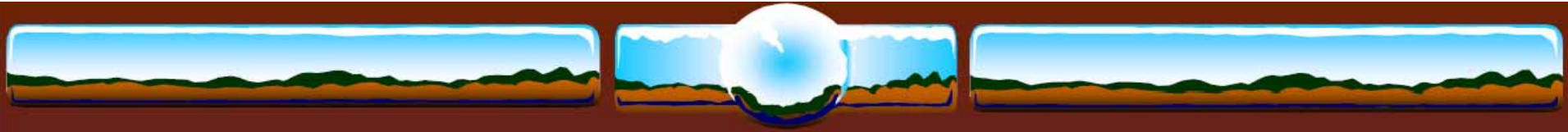
Shear loading.





# Fracture Mechanics (Cont)

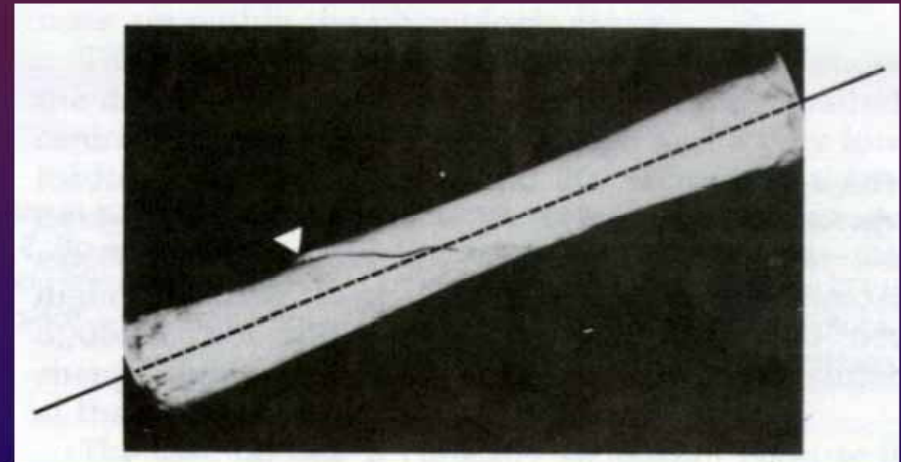
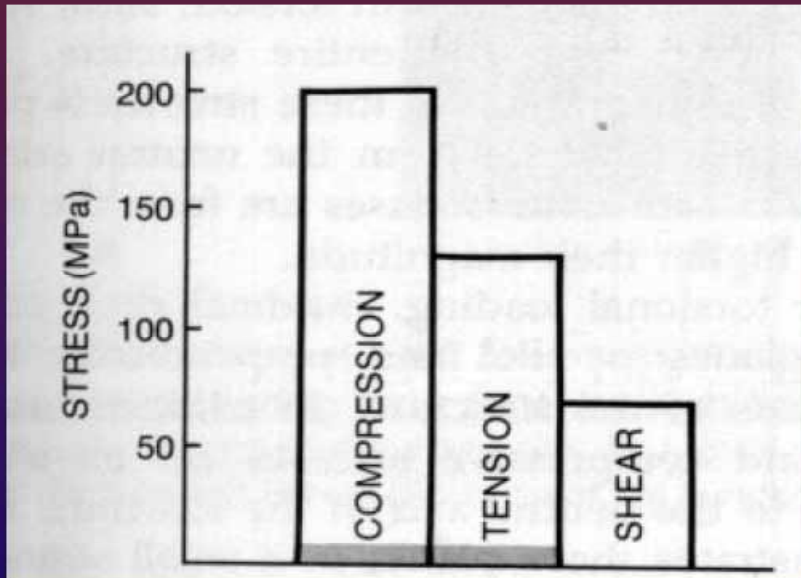




# Fracture Mechanics (cont)

❖ Ultimate Stress for bone

❖ Torsional fracture.



# Fracture Types

- Fractures are often classified according to the position of the bone ends after the break:

**Open (compound)** → bone ends penetrate the skin.

**Closed (simple)** → bone ends don't penetrate the skin.

**Comminuted** → bone fragments into 3 or more pieces. Common in the elderly (brittle bones).

**Greenstick** → bone breaks incompletely. One side bent, one side broken. Common in children whose bone contains more collagen and are less mineralized.

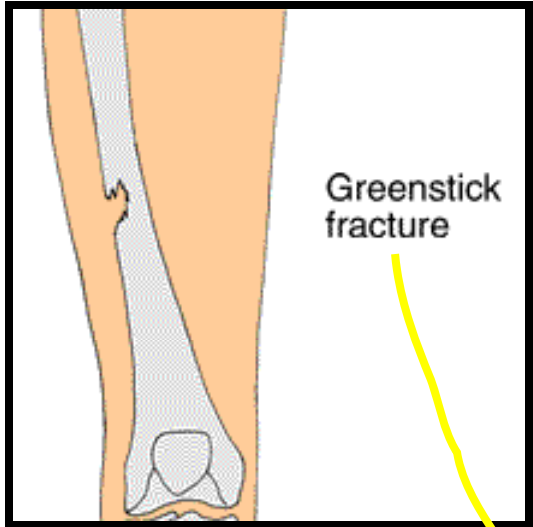
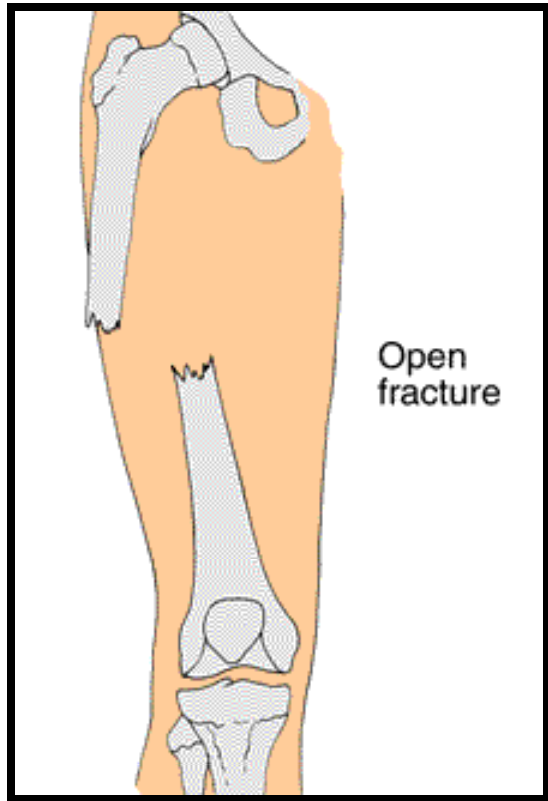
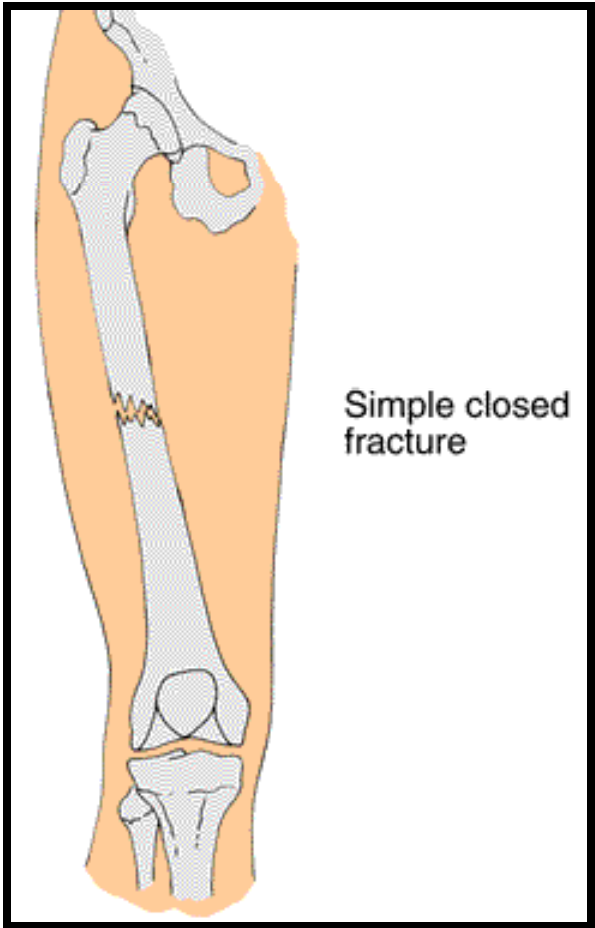
**Spiral** → ragged break caused by excessive twisting forces. Sports injury/Injury of abuse.

**Impacted** → one bone fragment is driven into the medullary space or spongy bone of another.

# Fracture Types

- *Spiral or Oblique*: bending or torsional loads fracture bone at oblique angle to long axis
- *Avulsion*: a tendon or ligament pulls the bone away (e.g., tensile loading during explosive jumping or throwing)
- *Greenstick*: incomplete fracture common in children due to larger proportion of collagen; bending/torsional loads





# Fracture Types

- *Comminuted*: fragmented into many pieces (most common during increased loading rates)
- *Simple*: One break, bone remains within the skin
- *Compound*: One break – but bone protrudes through the skin



# Stress Fractures

**Stress Fractures:** repetitive low-level loading, with inadequate time for bone remodeling

**Common sites:** tibia, metatarsals, femoral neck, pubic bone

**Often due to abrupt changes in training duration or intensity, or a lack of proper nutrition**



*What kind of fracture is this?*



*It's kind of tough to tell, but  
this is a \_ \_ \_ \_ \_ fracture.*

