Bone Repair Challenge
~Biomedical Engineering~
Bone Fractures

Many types of fractures, three common types are:

- **Compression**  
  (usually comminuted)
- **Torsion**  
  (usually spiral)
- **Side impact**  
  (usually oblique or compound)

Internal Fixation

Temporary or permanent fixtures directly attached to the bone under the skin for alignment and support.

- pins
- rods
- nails

- screws
- wires
- grafting
Internal Fixation

To determine the best repair technique, the break type and location are considered.

Example

Spiral fracture-torsion break

Tibia and fibula broken while skiing and repaired with a rod and pins.

*Image source:* Art's Spiral Fracture Pix, University of Arizona., http://dingo.sbs.arizona.edu/~hharley/skilegtext.html Used with permission.
Example: Rods, Plates and Screws

- **Rods** are used for alignment and support of long and large bones
- **Plates** hold together loose pieces of bone and support smaller bones
- **Screws** hold plates and rods in place

**Example: Rods, Screws and Pins**

**Pins** are similar to screws and usually affix a detached piece of bone.

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More Plates and Screws

X-ray example of shattered dog femur that was repaired with a plate and seven screws

Bone Grafting Example

A hip bone graft is used to fill a gap in a broken dog’s bone.

Medical Implant Materials

- Bone is an amazing material: strong and flexible
- Most human-made materials that are strong are also brittle
- To be accepted by the body and not cause other problems, the materials for rods, pins, screws and plates must also be biocompatible.
- Engineers design materials especially for medical implants that are made of:
  - Surgical stainless steels (blends of nickel, chrome and molybdenum)
  - Titanium alloys
  - Polymers
Your Design Challenge

• You will engineer a device to support the broken bone throughout healing.
• Your device will be tested in the same way the bone was broken. Can you make it stronger?
• Things to consider:
  – Strong?
  – Minimally invasive?
  – Compatible?
  – Inexpensive?
  – Ease of implementation?