

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)



Oblique



Comminuted



Spiral



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

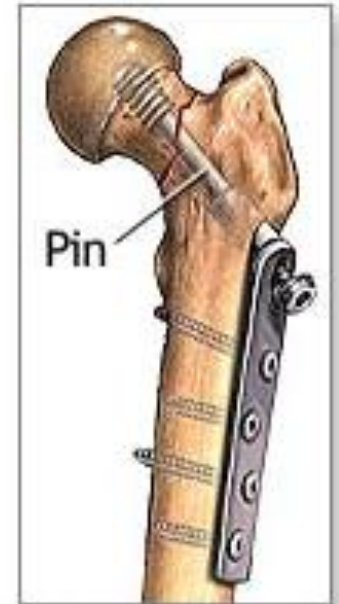
To determine the best repair technique, the break type and location are considered



Plate



Intra-medullary rod



Example

Spiral fracture-torsion break



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



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

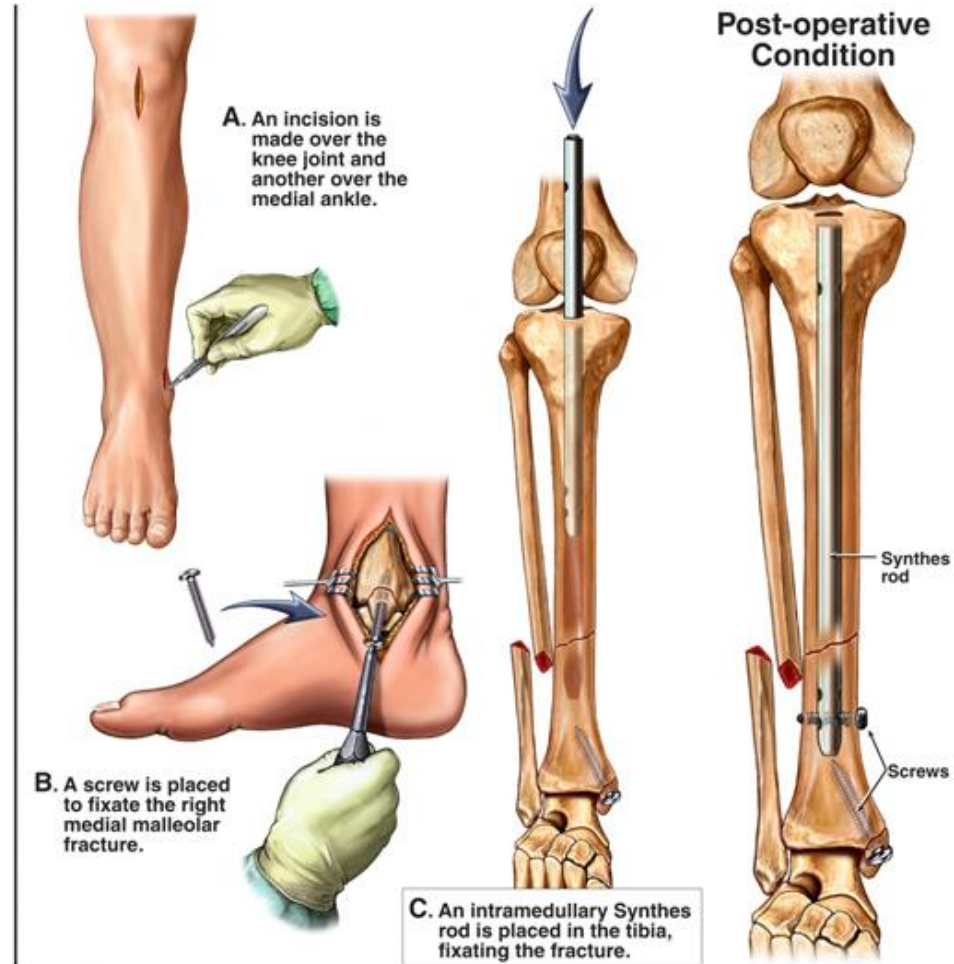


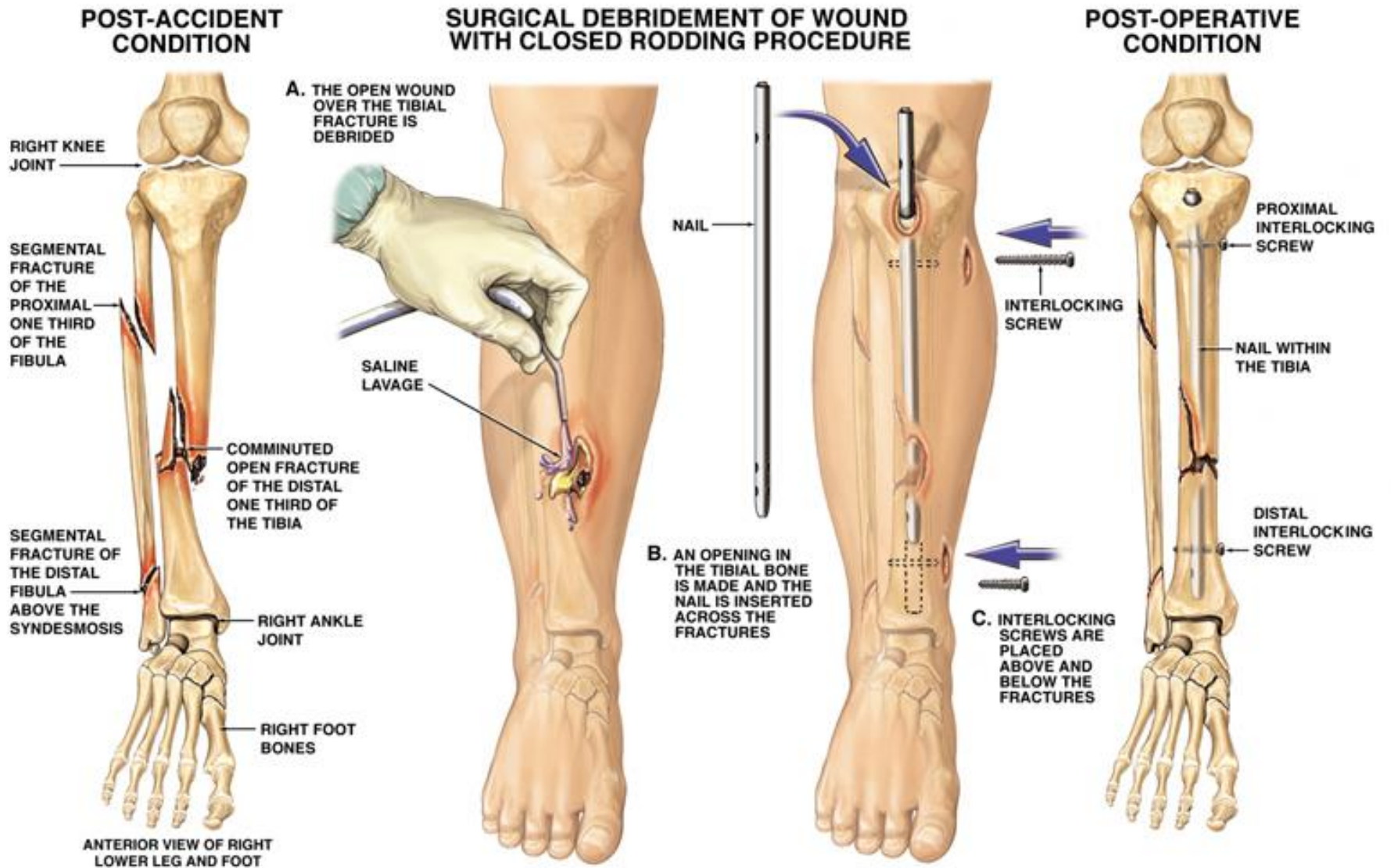
ADAM.

Example: Rods, Screws and Pins



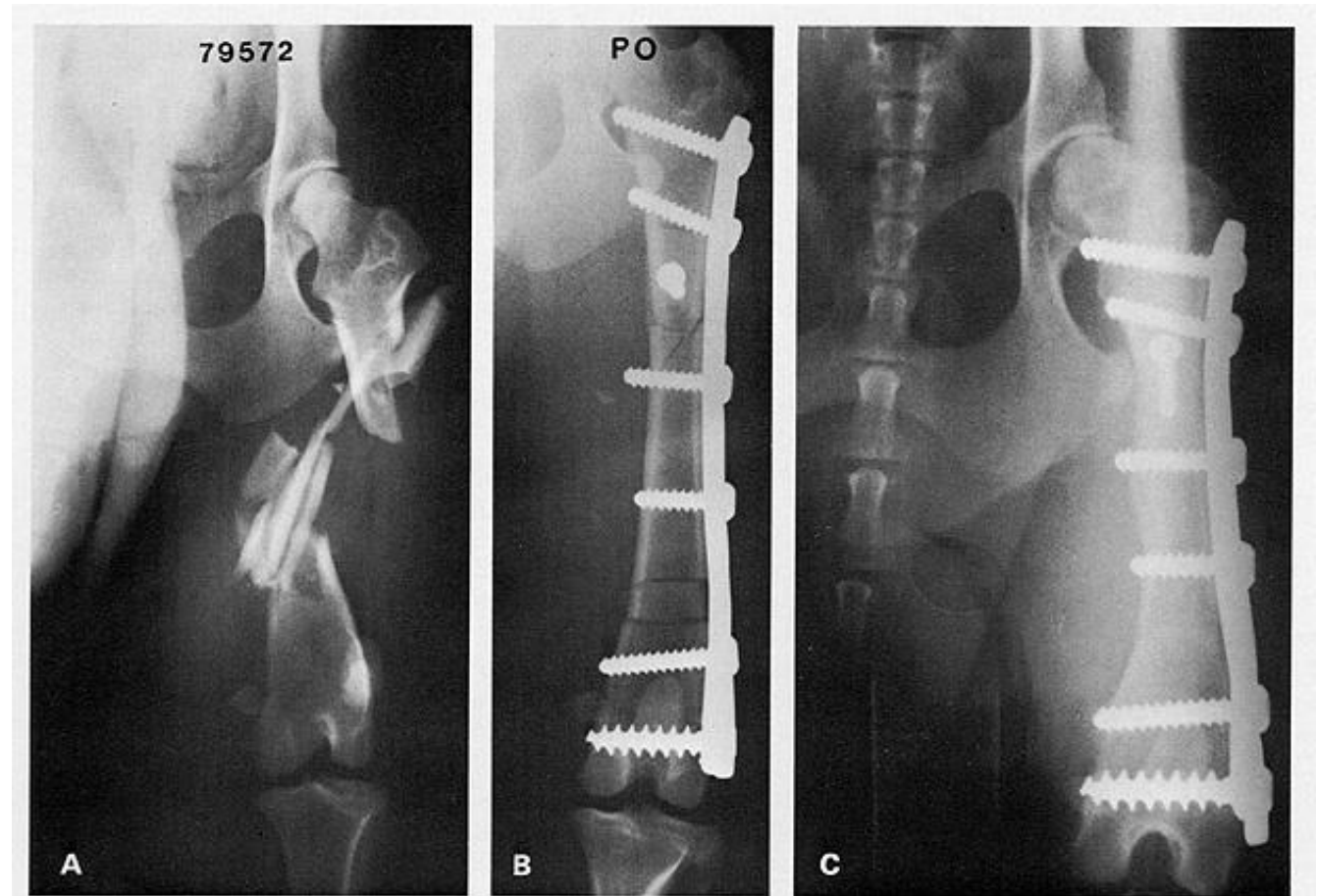
Pins are similar to screws and usually affix a detached piece of bone





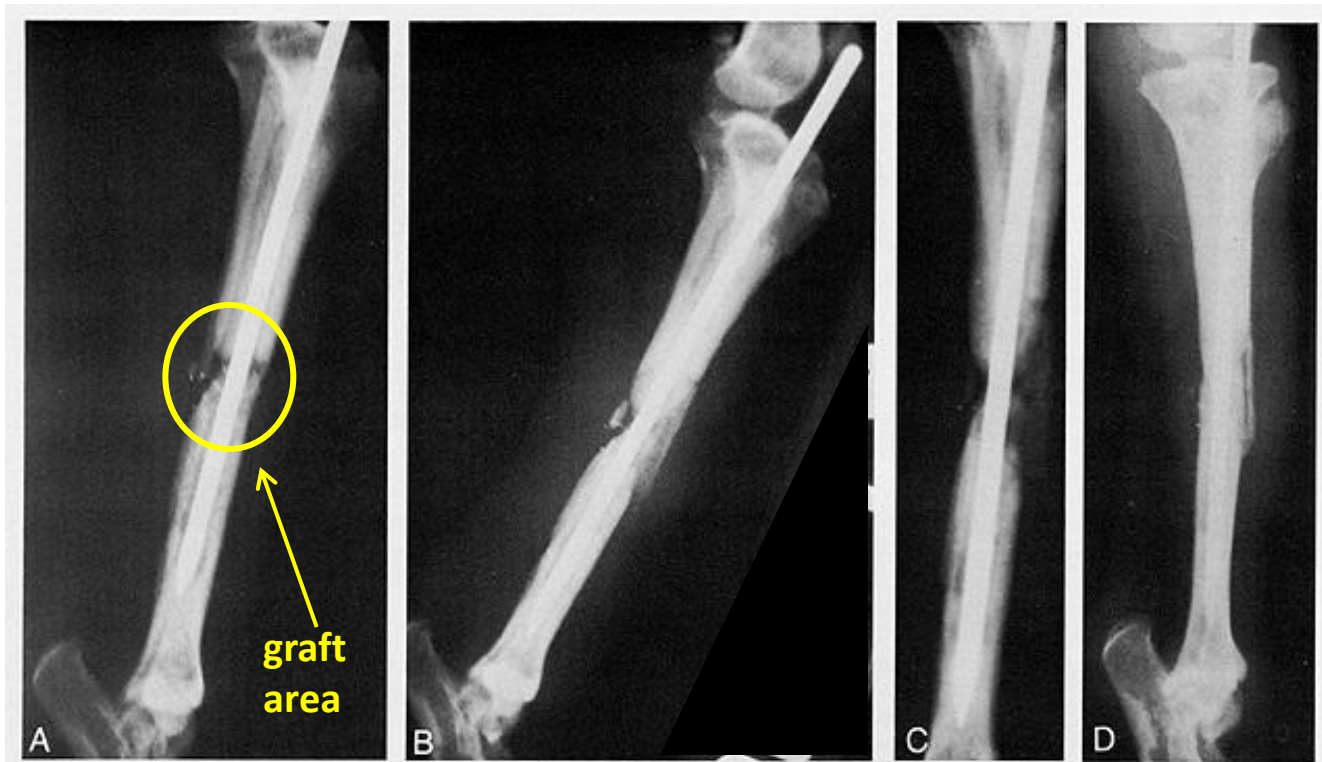
More Plates and Screws

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



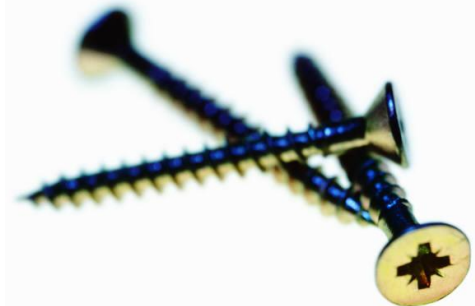
Bone Grafting Example

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?