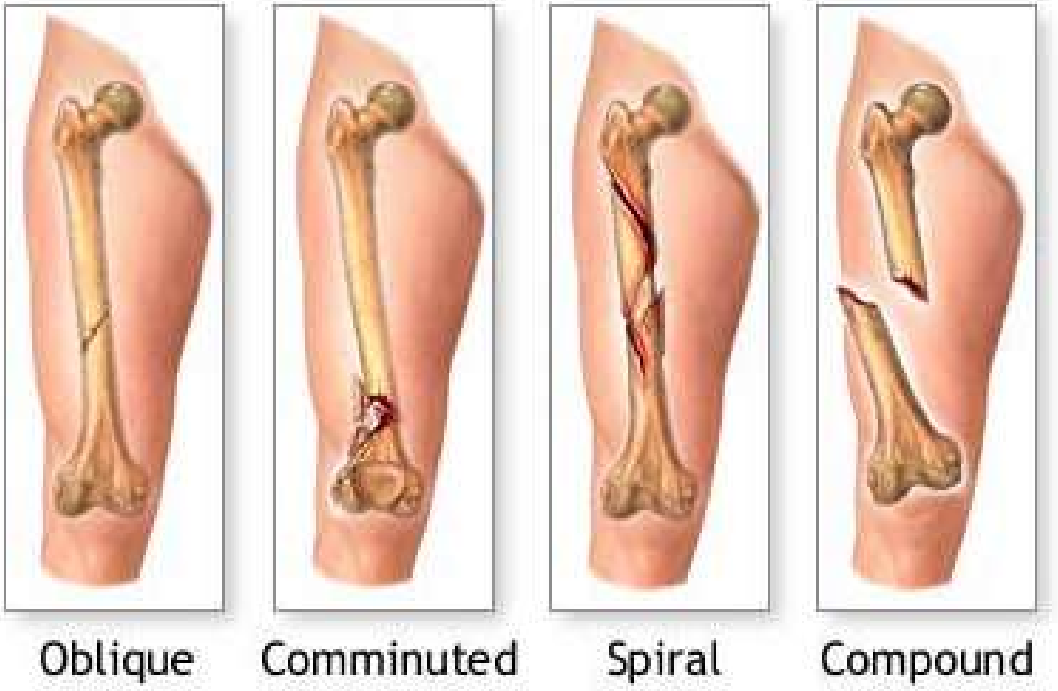
Bone Repair Challenge

~Biomedical Engineering~

Bone Fractures

Many types of fractures, three common types are:

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



A.D.A.M.

Image source: US National Library of Medicine, National Institutes of Health, Medline Plus, http://www.nlm.nih.gov/medlineplus/ency/imagepages/1096.htm

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

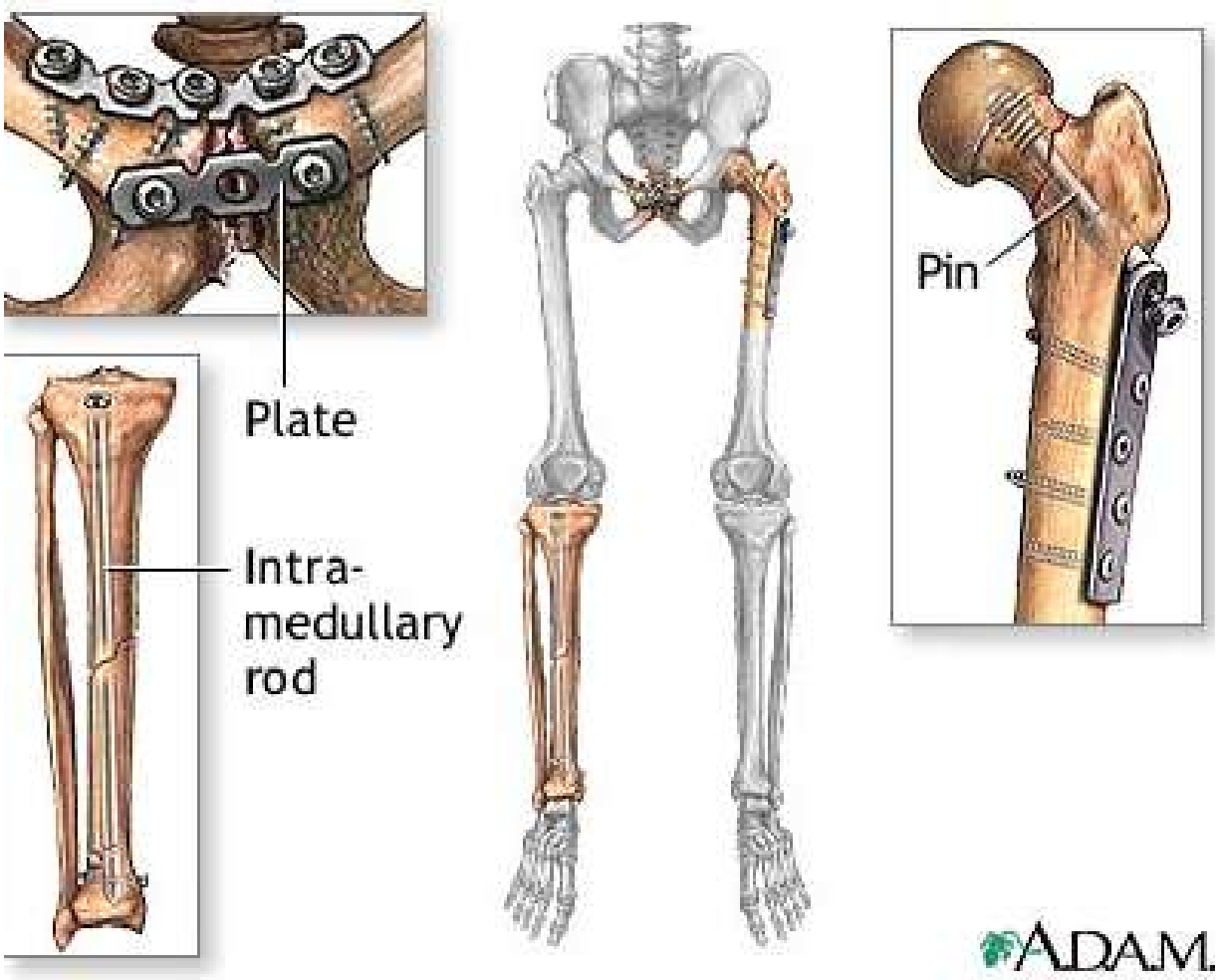


Image source: US National Library of Health, National Institutes of Health, Medline Plus, http://www.nlm.nih.gov/medlineplus/ency/presentations/100077_3.htm

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.

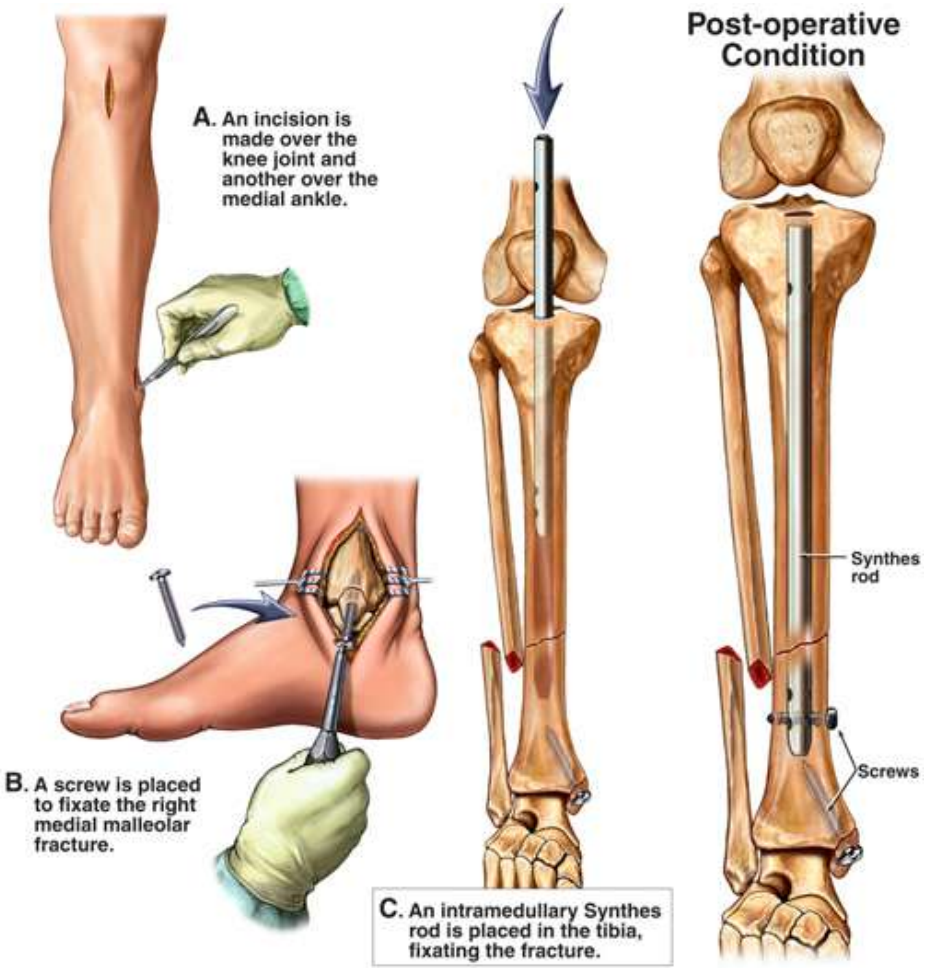
Example: Rods, Plates and Screws

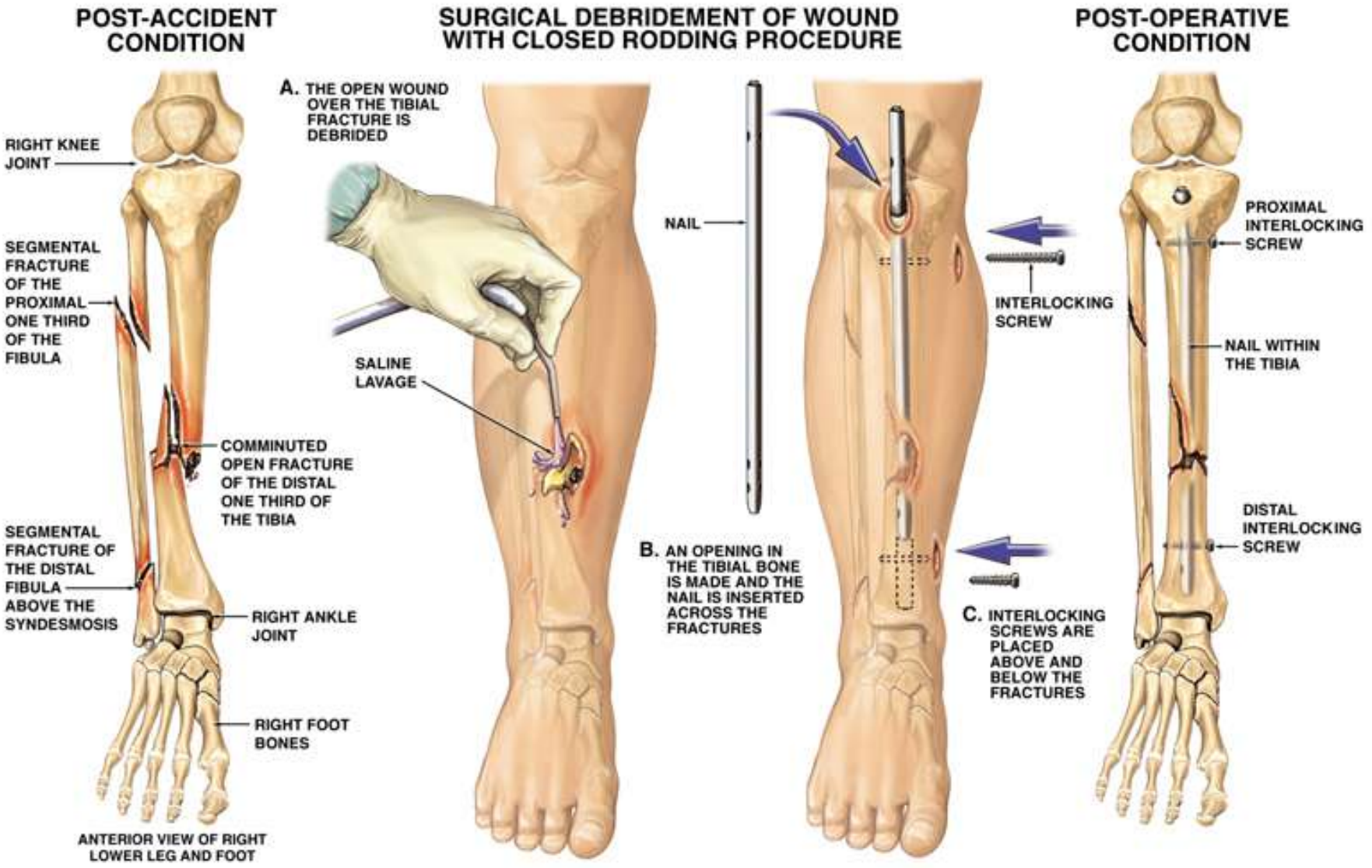
- **Rods** are used for alignment and support of long and large bones
- **Plates** hold together loose pieces of bone and support smaller bones
- **Screws** hold plates and rods in place

Image source: US National Library of Medicine, National Institutes of Health, Medline Plus, http://www.nlm.nih.gov/medlineplus/ency/imagepages/18023.htm

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

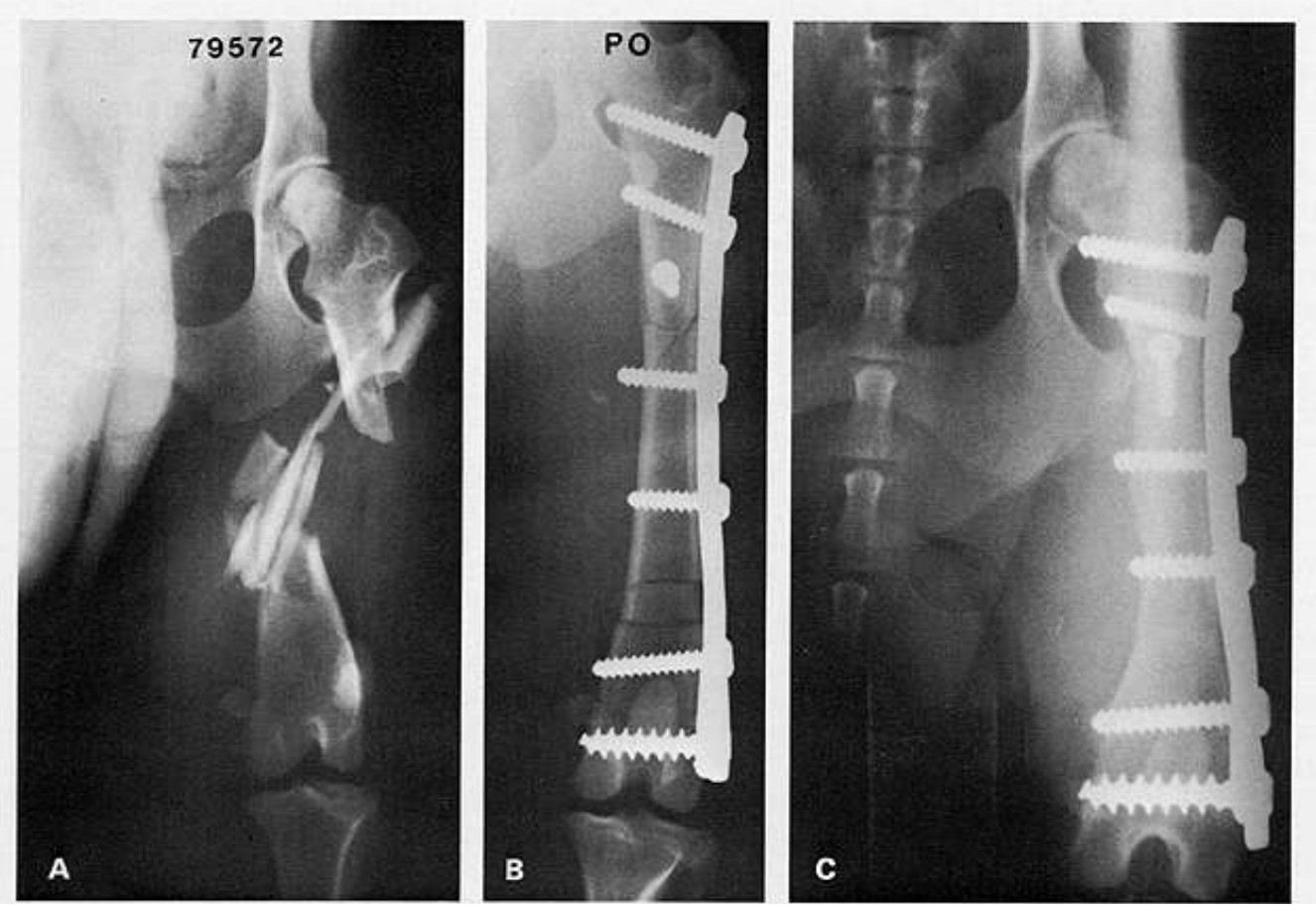
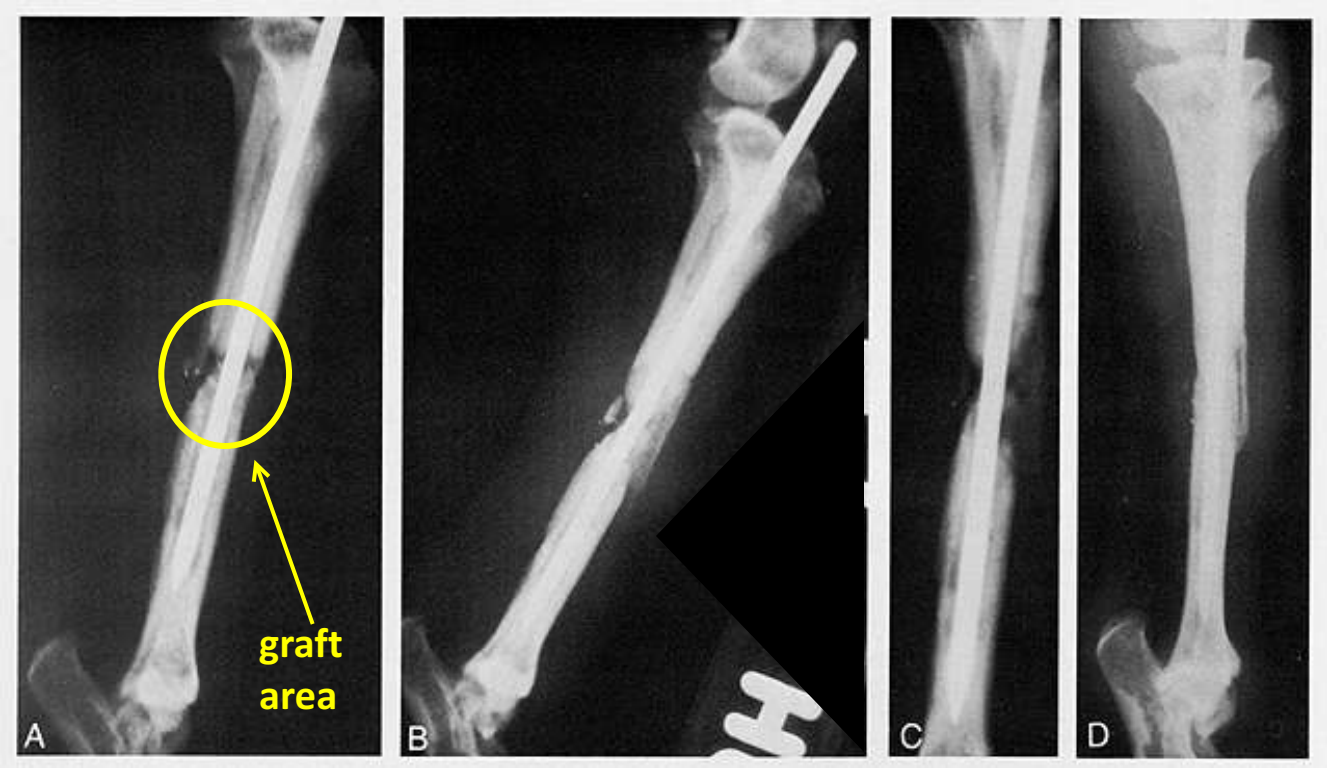


Image source: David M. Nunamker, University of Pennsylvania School of Veterinary Medicine. http://cal.vet.upenn.edu/projects/saortho/chapter_39/39mast.htm Used with permission.

Bone Grafting Example

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



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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?**