

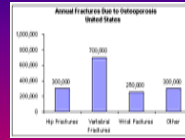
Osteoporosis

- causes bone fractures
- causes fragility
- progresses painfully



Osteoporosis Population

- About 10 million Americans have osteoporosis
- Estimated annual cost of osteoporosis is \$14 billion
- Annually, more than 1.5 million Americans have bone fractures due to osteoporosis, including 700,000 vertebral fractures



Effect of Osteoporosis

1 in 3 women

(usually occurs after menopause)

1 in 9 men

(occurs earlier in men than women)



Vertebral Fracture

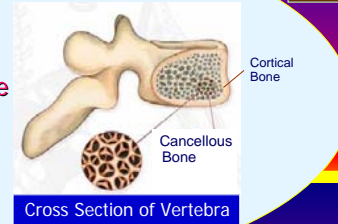


Current Treatments

- Hormone therapy
- Vertebroplasty
- Kyphoplasty

- 45-60 % Mineral: Calcium Phosphate**
- 20-30 % Matrix: Collagen**
- 10-20 %: Water**

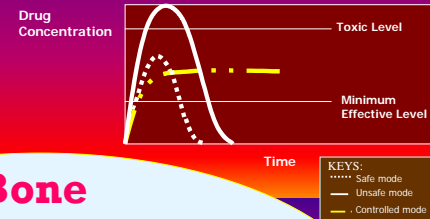
Bone



Cross Section of Vertebra

Drug Delivery

- A method to relieve the pain in the body
- Drug target at the wound site
- Figure – Drug concentration



Drug Concentration

- Ideally, we want the maximum number of nanoparticle in the bioactive hydrogel
- Why more nanoparticle?

Nanoparticle 1%	Nanoparticle 10%
X	Y Y Y Y Y Y Y Y Y Y

High concentration $X * 1 = 5$
Concentration 5

Low concentration $\bullet * 10 = 5$
Concentration 0.5

High drug concentration may be toxic

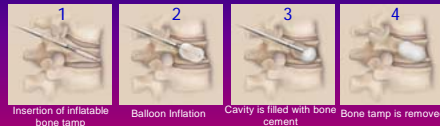
Vertebroplasty

Vertebroplasty literally means fixing the vertebral body. The Procedure of a vertebroplasty,

- Inject needle in the fractured vertebra
- Insert bone cement into the needle
- Let the bone cement harden
- Take the needle out



Kyphoplasty



Advantages of Kyphoplasty

- Reduce (set) fragility fractures
- Restore vertebral body height with a low risk of cement extravagation.
- Significant improvements in pain and function

Our Gel - Hydrogel

- Hydrophilic, crosslinked polymers that swell in water but cannot dissolve because of their network structure
- Diapers, biochemical separation techniques, pharmaceutical delivery systems and medical devices such as artificial organs



Our goal is to mimic the natural bone with a drug loaded hydrogel for Vertebroplasty.



Common bone materials for Vertebroplasty and Kyphoplasty

Polymethylmethacrylate (PMMA)



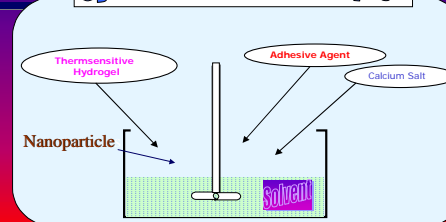
- Complications occurring after use of PMMA
- Mechanical loosening occurs because the cement never becomes incorporated with native bone
- Release heat in the body when PMMA hardens in vertebra

Calcium Phosphate



- Wicking water capacity equals 150% of dry weight
- Composition mimics natural bone minerals
- Biocompatible and biodegradable
- Direct bone attachment

Synthesizing our sample



ESEM photo of PLA spheres at 5000x magnification.

