Develop a Novel Bioactive Hydrogel as an Injectable Bone Material

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Background

Bone

Bone is a complex living tissue consists of collagen and calcium phosphate

Functions:
- support body weight
- protection of internal organs from mechanical damage
- reservoir of calcium and phosphate
- source of all the blood cell

Vertebral Fracture

Current Treatments
1. Hormone therapy
2. Vertebroplasty
3. Kyphoplasty

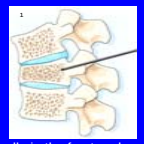
Both Vertebroplasty and Kyphoplasty are minimally invasive surgical procedures

Osteoporosis

- Causes porous bones.
- Causes bone fracture.
- Progresses painfully

Vertebroplasty

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



Inject needle in the fractured vertebra

Insert bone cement into the needle

Effect of Osteoporosis

1 in 3 women
(usually occurs after menopause)
1 in 9 men
(occurs earlier in men than women)

http://www.uel.ac.uk/hs/ScreeningDates.htm
http://www.inpensacola.com/fe/cityguide/seniors/articles/images/osteoporosis.jpg

Kyphoplasty

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

Common Injectable Materials

- Harden quickly within 20 minutes.
- Mechanical properties mismatch between the injectable materials and the bone.

CALCIUM PHOSPHATE

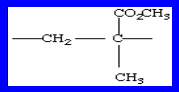
Mineral in our body calcium:phosphate in our bone is 1.79

- **Daily calcium requirements:**
  Birth - 6 months: 210 mg
  6 to 12 months: 270 mg
  1 to 3 years: 500 mg
  4 to 8 years: 800 mg
  9 to 18 years: 1300 mg
  19 to 50 years: 1000 mg
  50+ years: 1200 mg

Polymethylmethacrylate

PMMA (ie : acrylic nail polish)

Chemical STRUCTURE:



We propose to use Bioactive hydrogel as bone replacement.

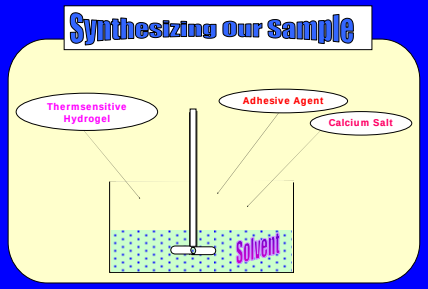
HYDROGELS

- Water swollen crosslinked polymers
- Some are PH sensitive or heat sensitive
- Combines with other acrylic monomers to adjust properties

Bioactive Hydrogels

. Our bioactive hydrogel would be in liquid form at room temperature

- Grows spontaneously by consuming calcium and phosphate from the surrounding biological environment
- It would be firmed at body temperature



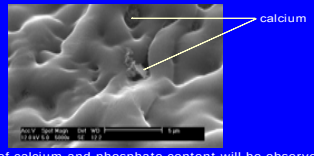
Method

1. Purify the polmer.
2. Weigh the ingredients for the sample.
3. Dissolve the mixture in the solvent
4. Vaccum dry the sample at 25 C for one day
5. Grind the sample to a fine powder
6. Dry the powder for analysis.

Samples Analysis

The Environmental Scanning Electron Microscope [ESEM]

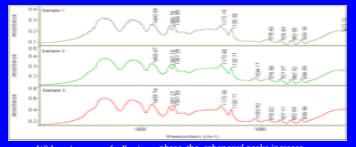
ESEM Image



An increase of calcium and phosphate content will be observed.

Fourier transform infrared spectrometer system (FTIR)

Absorption Spectra



With an increase of adhesive phase, the cabonoxyl peaks increase.