



Determine the Bioactivity of a Novel Bioactive Hydrogel



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What is Bone?

- 20-30% Collagen: soft framework
- 45-60% Calcium Phosphate: adds strength and hardness
- 10-20 % Water



Osteoporosis

- "porous bone"
- low bone mass
- deterioration of bone tissue
- bone fragility
- increased susceptibility to fractures



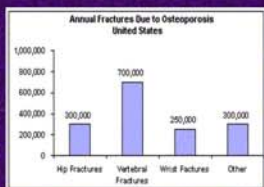
Effect of Osteoporosis

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



Osteoporosis Population

- About 10 million Americans have osteoporosis.
- More than 1.5 million Americans have bone fractures due to osteoporosis, including 700,000 vertebral fractures every year.
- Annual cost of osteoporosis is about \$14 billion.



Vertebral Fracture



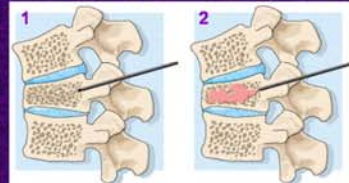
Current Surgical Treatments

1. Vertebroplasty
2. Kyphoplasty

Both Vertebroplasty and Kyphoplasty are minimally invasive surgical procedures

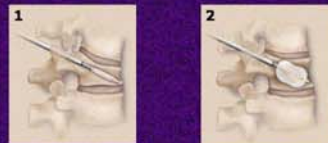
Vertebroplasty

Vertebroplasty literally means fixing the vertebral body.



Inject needle in the fractured vertebra. Insert bone cement into the needle.

Kyphoplasty



Insertion of inflatable bone tamp. Balloon inflation.



Cavities filled with bone cement. Bone tamp is removed.

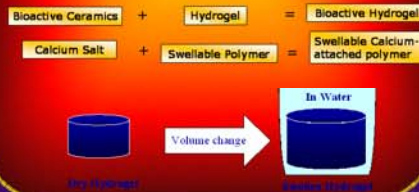
Advantages of Kyphoplasty

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

BIOACTIVITY

The ability of a material to enhance bone tissue formation and bond to bone tissue

Our Proposed Material Bioactive Hydrogel

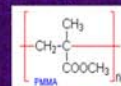


Current Injectable Materials for Vertebroplasty and Kyphoplasty



1. Poly (methyl methacrylate) PMMA

- bone cement used in fracture fixation
- adds strength to the vertebral body and reduces pain
- needed to be performed under high pressure or it will leak into the body.



2. Calcium Phosphate

- biocompatible
- allow bone attachment
- bone ingrowth
- chemical similar to natural bone



Problem:

Current bone cements harden very quickly (within 20 minutes), which would lead to complications during surgery. Therefore, an improved injectable bone material is essential.

Hydrogel

- hydrophillic
- crosslinked polymer that swell in water
- does not dissolve
- stimulate growth
- wide range of uses
 - diapers
 - pharmaceutical delivery systems



Procedure

1. Calcium phosphate hydrogels were immersed in SBF for one, three or seven days in water bath at 37°C.



2. Field emission environmental scanning electron microscopy (FE-SEM) was used to determine growth of calcium phosphate on the hydrogel.



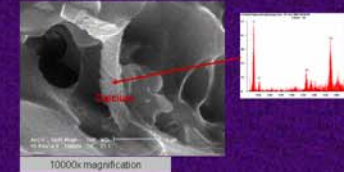
3. Specimens were ultrasonically washed



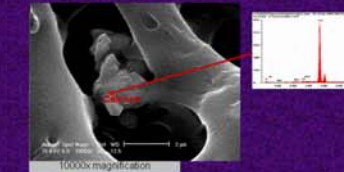
4. vacuum dried to room temperature



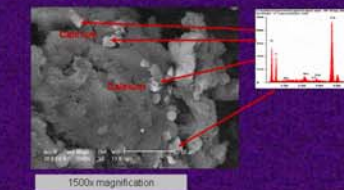
Day Zero



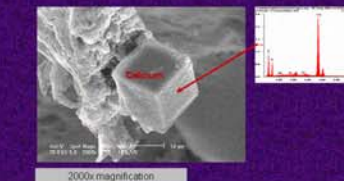
Day One



Day Three



Day Seven



Conclusion

- Our proposed material successfully enabled to provide bioactivity within the hydrogel matrix.

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Dr. Mary Poats