## Fast Casters – Project Update February 16, 2006

Rene Chen
Byron Hsu
Kimberly Kam
Kelsey Vandermeulen
Lisa Witmer

## Objectives

- Progress since last update
- New project candidates
  - Technology of speed skate blade
  - 3-D printing of bone scaffolding



# Important Material Characteristics in Speed Skates



Strong, resistant to wear

Low thermal conductivity

Able to be sharpened

#### Titanium vs. Steel Blade

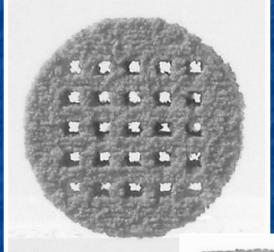
- + Increased durability
  - + Needs to be sharpened less often
  - Sharpening takes time and may dull the tools

	Steel	Titanium
Thermal Conductivity [W/m-K]	15.2	6.7
Hardness, Vickers	153	349
Cost [USD/lbs.]	\$0.18	\$4.50

# Challenges

- Analyzing advantages and difficulties of using a titanium blade
- Analyzing advantages of casting over forging or water jet cutting
- Finishing the blade

# 3D Printing of Hydroxyapatite Bone Scaffolds



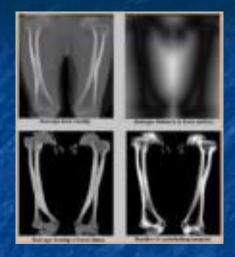
#### Objective

 3D porous hydroxyapatite scaffold for bone replacement customized from patient's CT scans



Seitz et al, Wiley Periodicals

#### The Process



CT scan from patient



CAD image of bone replacement



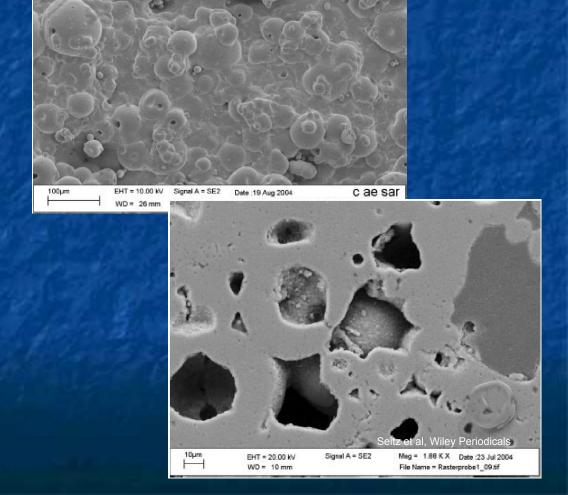
Bone scaffold fabricated from 3D printer



Surgeons implant customized scaffold into patient

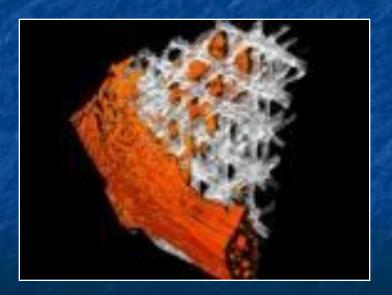
Requirements of HA Bone Scaffolds

- Porosity
- Strength
- Interconnected channels
- Channel size
- Biocompatibility
- Bone ingrowth

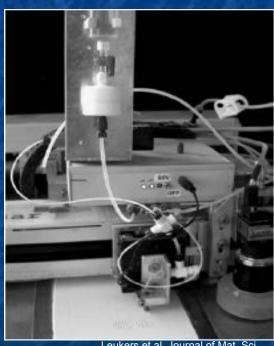


## Hydroxyapatite

- $Ca_{10}(PO_4)_6(OH)_2$
- Chemically similar to the component of bones
- Supports bone ingrowth
- Biodegrades in the body over time
- HA in powder form



## Why HA Bone Scaffolds Would Benefit from 3D Printing



Leukers et al. Journal of Mat. Sci

- Rapid prototyping
- Quick customization using CT scan of patient
- Complexity of scaffold

## Challenges of 3D Printing Hydroxyapatite Scaffolds

- HA particle size
- Acceptable binder
  - polymeric
- Small enough size resolution
- Time constraints
- Sintering
  - Shrinkage
- Cell culture



#### The Game Plan

- Explore different combinations of hydroxyapatite and biocompatible materials
- Uniaxial tension/compression tests
- SEM imaging of microstructure
- Different channel geometries

# Questions/Comments?

# Backup/Extra Information

#### **Material Candidates**

- Spray-dried hydroxyapatite granulates with polymeric additives V5.2 and V12
- Polymeric binder Schelofix dissolved in water (10 and 14wt%)
- Hermann Seitz, "Three-Dimensional Printing of Porous Ceramic Scaffolds for Bone Tissue Engineering", Wiley Periodicals, 2005.