# Artificial Bones

Nicole Normandin
March 1st, 2004
Biomedical Engineering Seminar
ELE 282

The days of metal implants reinforced with steel pins setting off airport metal detectors are quickly dwindling. Old solutions to bone replacements are only temporary fixes and there is an increasing demand for something permanent.

Two solutions are currently in the research phase and will soon be on to clinical trials. One is a 3-D imaging technique and the other is a polymer called hydroxyapatite.

The 3-D imaging works by using tools such as magnetic resonance imaging (MRI) and computer aided tomography (CAT), the bones or bone segments which need to be replaced are scanned to create the 3-D image. This image is then fed into a computer-controlled machine which essentially prints the bone out. The machine is specially designed to use a polymer and build it slowly, layer by layer, into an exact replica of the original bone. This replica bone is so strong it won't need steel pins for reinforcement.

How the hydroxyapatite works like the following: hydroxyapatite is created by starting with a powdered mixture containing many of the same elements of real bone. This mixture is then heated to very high temperatures, allowing for a chemical reaction to take place. The new substance formed is very similar in its properties to real bone. Gases released during the heating process are trapped, creating a porous material. These pores allow for blood vessels to travel through while also cutting down on the weight of the bone itself. Once this "bone" has been created, it is layered with a scaffolding. Briefly mentioned before, a scaffolding is simply a surface on which healthy cells are cultured. Once enough cells have grown, the hydroxyapatite is introduced to the scaffolding. This is said to "facilitate the all-important bond between implant and the surrounding tissue." The goal of this is to eliminate inflammation and infection commonly associated with metal implants foreign to the body. The body is then expected to absorb the implant as it would any other familiar biological structure.

Hydroxyapatite has a relatively short history, starting in the field of plastic surgery. It has been used in recent years as facial implants due to its compatibility with the human body.

If successful, the generic technology involved in producing this artificial substitute for human bone could also lead to new approaches to the repair of damaged organs in the body, like the pancreas and the liver.

The ultimate goal of the research is to engineer materials which could enable the body to regenerate damaged or diseased tissue - such as cartilage in arthritis patients, or bone in patients with osteoporosis.

The aim of this research project is to produce artificial bone that is bioactive, that is, mechanically and biologically compatible with the human body.

Sources:

[http://www.worldhealth.net/p/393,2033.html](http://www.worldhealth.net/p/393,2033.html)

[http://www.lbl.gov/Science-Articles/Archive/MSD-building-better-bones.html](http://www.lbl.gov/Science-Articles/Archive/MSD-building-better-bones.html)

[http://www.admin.cam.ac.uk/news/dp/2002020401](http://www.admin.cam.ac.uk/news/dp/2002020401)