Injectable Matrix for Load-Bearing Bone Repair

Summary

Dr. Huakun Xu and his team at UMB have created an injectable and mechanically strong construct to be used with or without stem cells for bone tissue engineering.

Key Investigator
Huakun Xu
Michael Weir

Field
dental

Technology
Dental restoration
Composite

Technology Status
Injectable scaffold optimized and in vivo studies underway

Status
Available for licensing
Available for sponsored research

Patent Status
HX-2010-041: US patent application 13/695,122 filed 10/29/2012
HX-2012-027: US 9,427,491 issued 8/30/2016
EU 12 841 976.9 filed 5/21/2014
CON 15/241,950 filed 8/19/2016

UMB Docket Reference
HX-2010-041, HX 2012-027

Reference
Acta Biomater. 2014 Oct; 10(10): 4484-93.
Dent Mater. 2012 Oct;28(10): 1059-70.
Biomaterials. 2010 Sep;31(25); 6502-10.

Market

Autograft bone has historically been the standard of care for repairing bone, but its use is limited by availability and medical problems that patients experience at the bone harvest site. Allografts also have their limitations which include infections and tissue rejection. Alternative bone substitute materials have been developed, using natural and synthetic polymers, ceramics, and composites, some incorporating cell-based strategies. Despite the many advances in bone graft substitutes, there remains a real need for an alternative with optimal bone regeneration properties.

A May 2008 report by Epsicom Business Intelligence declared that the "orthobiologics" market is the fastest growing segment of the global orthopedics market. There are more than three million musculoskeletal procedures performed annually in the U.S. of which about half involve an autograft or allograft. Worldwide, autografts and allografts are used in approximately 2.2 million orthopedics procedures annually.

Technology

The UMB inventors have designed a strong, moldable, and injectable stem cell-containing scaffold for bone tissue engineering that can be used in minimally-invasive surgical procedures for dental and craniofacial reconstruction and orthopedic applications. The three main elements of this scaffolding material are: (1) a CPC paste, (2) stem cell-containing beads, and (3) polymer fibers. The CPC paste hardens to a microcrystalline hydroxyapatite and has been improved with biofunctionalizing agents to facilitate stem cell attachment, proliferation, osteogenic differentiation, and bone mineral synthesis. Encapsulating stem cells into degradable beads allows a homogenous distribution of cells when mixed with the CPC paste. When the beads degrade, the result is a stem-cell containing macroporous structure. The polymer fibers contribute early load-bearing capacity, to be replaced gradually by natural bone over the course of healing. The inventors demonstrated that the mechanical properties of the biofunctionalized CPC scaffold match the reported strength and elastic modulus of cancellous bone. Work is underway in animal models to measure bone healing over time following treatment of cranial defects.

Advantages

Can be used for:

(a) tissue engineering scaffolds that are injectable but lack mechanical strength

(b) polymer blocks or donor tissue shaped to fit into a defect but which require more extensive surgery to fit.

Contact: Mark Wozniak
mark.wozniak@umaryland.edu
410-706-7293

University of Maryland, Baltimore
620 W. Lexington St., 4th Floor
Baltimore, MD 21201