McGowan Institute for Regenerative Medicine
A program of the University of Pittsburgh and UPMC

Designing 3D-Printed Materials to Help the Body Heal Itself

In the laboratory of McGowan Institute for Regenerative Medicine affiliated faculty member Prashant Kumta, PhD, the Edward R. Weidlein chair professor at the University of Pittsburgh Swanson School of Engineering and School of Dental Medicine and professor in the Departments of BioEngineering, Chemical and Petroleum Engineering, Mechanical Engineering and Materials Science, and Oral Biology, one of the visions is to revolutionize metallic biomaterials and technologies to create life changing devices. This will lead to engineered systems that will interface with the human body to prolong and improve quality of life, specifically with craniofacial and orthopedic applications. Dr. Kumta and his team's goal is to engineer logical and clinically relevant options that could regenerate mineralized tissue (bone/tooth) formation utilizing a unique combination of evolutionary load-bearing biodegradable materials (metals), growth factors, and cell therapy.

Recently, Rosanne Skirble of *Voice of America News* reported (video here) that Dr. Kumta and his team of graduate students are designing 3D-printed materials that are a match for the patient's body, and are absorbed or excreted as new tissue grows and the wound heals. In the laboratory, Dr. Kumta's team has developed both magnesium and iron alloys to use as the materials' base. He calls magnesium — a mineral needed for more than 300 biochemical reactions in the body — "a perfect fit" for the technique.

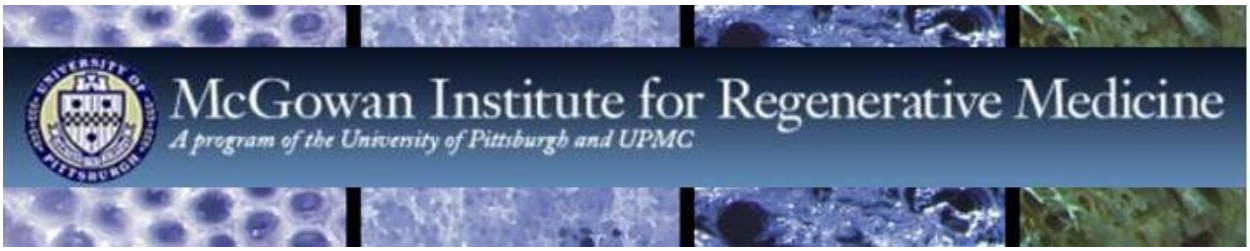
"It has the mechanical characteristics that meet natural bone, both from the strength [and] the toughness as well as the density. It has the perfect density that will match with natural bone," he said.

Dr. Kumta's team is also working with a novel formulation of calcium phosphate putty that can be injected to fill spaces between fractured bones. A 3D-printed biodegradable plate or screw would hold that filler in place.

"The fixation plate will provide the mechanical strength needed to carry the load, and the bone-wide filler would help provide the healing and the bone formation," he said.

Pre-clinical trials are now underway in animals. Dr. Kumta said the work is revolutionary, offering the prospect of a better outcome for the patient.

"Rather than implanting a screw or plate or joint," he said, "doctors could give the body's own regenerative ability a more effective method to heal itself."



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