System for Bone Regeneration (#4660)

Georgia Tech researchers have developed a delivery system for growth factors to the human body that improves growth factor retention and allows for tissue regeneration within an enclosed space. The technology has been used for the repair of a small animal bone segmental defect. While much bone regeneration research is focused on the use of three-dimensional scaffolds that support loading in vivo, these scaffolds usually do not provide an optimal environment for cellular function and suffer from slow resorption kinetics. However, recently we have shown that electrospun nanofiber meshes possess a number of features that improve cell attachment, morphology, and function and promote tissue regeneration. When a growth factor is delivered within a tubular nanofiber construct to a critically-sized segmental bone defect, uniform accelerated bone regeneration was observed compared to controls and other scaffolds. Results have shown that compared to the clinical standard collagen sponge, the mesh/hydrogel system with the same dose of BMP-2 promoted significantly more bone in growth and higher mechanical strength at 12 weeks. Perhaps most importantly, the mesh/hydrogel system had biomechanical strength equivalent to age-matched intact (i.e. uninjured) femurs. Results from large animal studies are anticipated in 2012.

Benefits/Advantages

- Provides superior retention and release of osteoinductive protein
- Reduces necessary dose of osteoinductive protein
- Reduced cost of procedure
- Reduces the release of osteoinductive protein to non-target tissues

Potential Commercial Applications

- Regenerate tissue that has been damaged due to disease or trauma
- Bone graft substitute
- Orthopaedic trauma (tibial fractures and segmental defects)
- Spine fusion
- Oral maxillofacial defects
- Cartilage, tendon, ligament, and muscle regeneration

Background/Context for This Invention

It is well established that the incorporation of certain types of carbon nanofibers into polymeric materials can impart electrical conductivity to such materials that are generally regarded as insulators. Carbon nanofibers can be dispersed in a polymer by various well-known techniques such as melting and kneading

to form an admixture that can be subsequently shaped to form an electrically conductive article. The use of conductive nanofibers is highly desirable since a given weight of such a material generates a large number of contact points within a polymer matrix. The widespread interest in electrically conductive polymers is stimulated by the possibility that such materials can have utility in such things as semiconductor chips, integrated circuits, lightweight battery components, sensors, electro-chromic displays, anti-static coatings, static dissipation, electromagnetic and radio-frequency interference shielding, fuel hoses, connectors and packaging items.

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More Information

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Publications

For more information about this technology, please visit:
https://licensing.research.gatech.edu/technology/system-bone-regeneration

Images:

The automated sequential delivery of multiple fluids. A varying number of delay gates imprinted in the branches are shown in the figure.

COVID-19 and flu saliva test on paper: (A) The automatic sequential delivery of multiple reagents required for virus test; (B) Water pouring into the device triggers the virus assay, allowing the presence of SARS-CoV-2 and influenza A & B viruses to be visually identified by the color changes in the corresponding detection spot