

LOW-COST, SYNTHETIC HYDROGEL SCAFFOLD TO PROMOTE NERVE GROWTH AND REGENERATION

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Technology Description

Engineers led by Dr. Donald L. Elbert have developed a patented, self-assembling hydrogel microsphere scaffold system designed to improve tissue regeneration by creating cell migration pathways to repair large nerve gaps. This technology generates the migration pathways by controlling the rate that chemical crosslinks between the microspheres are degraded by plasmin (an enzyme activated by Schwann cells). This degradability gradient provides the correct balance of porosity and structural strength over time for growing tissue to gradually replace scaffold cells. The invention could enable cells to migrate further and bridge larger gaps between injured nerve ends than traditional nerve conduits. In addition, the microspheres can be loaded with cell adhesion molecules, growth factors and growth factor-binding molecules to further enhance cell migration. The modular, synthetic microspheres are fabricated with low cost materials and can be engineered with predictable properties customized for their end user application.

Stage of Research

The inventors have fabricated an almost entirely synthetic nerve guidance conduit (NGC) from polyethylene glycol (PEG) microspheres with tunable plasmin degradability. The NGCs delivered a soluble growth factor and promoted robust nerve regeneration in a rat model of peripheral nerve injury with no infection, necrosis or foreign body response.

Applications

- **Peripheral nerve regeneration** – microsphere scaffold forms nerve guidance conduit to promote cell migration and nerve repair after injury
- **Tissue scaffold** – hydrogel could be customized to promote growth and generation of new functional tissue using biomaterials

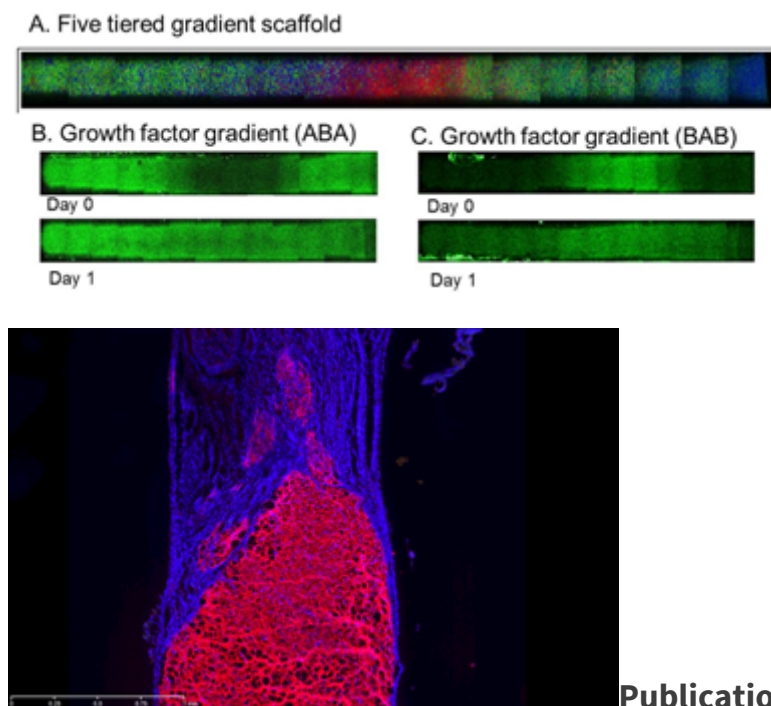
Key Advantages

- **Improve rate of regeneration:**
 - scaffold provides pathways to allow cells to migrate further into the hydrogel material
 - potential to bridge larger nerve gaps than current grafts and conduits
- **Customizable, modular engineered material**
 - the size of the pathway can be controlled to meet specific needs by changing the size of the microspheres and degradation properties
 - modular microsphere hydrogel simplifies formation of concentration gradients
 - synthetic hydrogel material has predictable properties compared with variable biological

grafts

- should enable broader applications to regenerate tissue over a longer distance
- **Low cost** – hydrogel material is expected to be affordable because it is fabricated from commonly available raw materials using well-established techniques
- **Self-assembly** – microspheres assemble themselves with no human or machine involvement

Nerve Regrowth with Gradient Scaffold



- Roam, J. L., Yan, Y., Nguyen, P. K., Kinstlinger, I. S., Leuchter, M. K., Hunter, D. A., ... & Elbert, D. L. (2015). [A modular, plasmin-sensitive, clickable poly \(ethylene glycol\)-heparin-laminin microsphere system for establishing growth factor gradients in nerve guidance conduits](#). *Biomaterials*, 72, 112-124.

Patents

- Hydrogel microparticle scaffold with gradients of degradability and methods thereof ([U.S. Patent No. 10,137,082](#); [U.S. Patent No. 10,682,309](#))