MaR-VeL: Novel 3-D Magnetic-Controlled Bioprinted Encapsulation & Robotic Systems for Enhanced Stem Cell Integration and Regeneration

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One of the biggest hurdles to Stem Cell Therapies' clinical applications has been the difficulty in delivering stem cells safely and retaining them at the target site without migrating uncontrollably. To overcome this, a novel device named MaR-VeL: Magnetically Responsive Vessel for Engineered Localization was created to address these challenges. This improved system from primitive types utilizes over 100 shapes, sizes, and hook structures, designed to supply encapsulated stem cells precisely to the target tissues and remain there, allowing for cellular survival, integration, and differentiation. 3D printing was utilized to create a small, injectable device with the use of biocompatible materials such as alginate, chitosan, collagen, and hyaluronic acid methacrylate that provide support for cell viability. MaR-VeL is also embedded with a magnetic field that allows for precise external guidance, which directs the encapsulated stem cells to target tissues. The magnetically guided approach enhances cell integration, survival, and differentiation within the desired environment. The cytotoxicity of the design was rigorously tested with different concentrations of magnetic materials and a fluorescence microscope to ensure a safe and effective system to present a transformative step forward in regenerative medicine.

Awards Won: