Gel-like padding could help cells survive injection, heal spinal cord injuries

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(Medical Xpress)—A team of Bio-X scientists is developing a gel to help protect cells from the trauma of being injected into an injury site. The work could help speed cell-based therapies for spinal cord injuries and other types of damage.

It is a turbulent and sometimes deadly life for cells injected to heal injuries. The act of being squirted through a thin needle into the site of an injury jostles the delicate cells against each other and against the needle walls. Then, once in the site of injury, they face a biological war zone of chemicals. It's no wonder, then, that treating spinal cord injuries and other damage with injected cells has been a challenge.

Solving this problem takes more than biological know-how; it takes padding – chemical padding in the form of complex molecules called polymers that bathe and protect the cells but also flow smoothly through thin needles.

Sarah Heilshorn, an associate professor of materials science and engineering at Stanford, equates these gel-like polymers to ketchup. It's pretty thick, but when you bang on the bottle the sauce flows smoothly through the neck, then firms back up on the plate – a process she calls self-healing. "We want our polymers to self-heal better than ketchup," she said. "It flows a bit across the plate."

Her goal is to develop a polymer that supports the cells when they are loaded in a syringe, but then flows freely through the needle, padding

and protecting the cells, then firming up quickly when it reaches the site of injury. "We don't want the cells to flow away," she says.

Heilshorn sees this technology as a platform that could be applied to a variety of cell types and injuries. Some polymers need to be firmer to support cells that like a harder environment. Others need to be softer, or contain different biochemical signals.

Neural stem cells, for example, are more likely to mature into nerves if they are in a soft environment. In a stiff environment, they tend to form supportive cells called astrocytes. Picking the right gel is critical to delivering the right kind of cells.

The biochemicals contained within the gel also matter. "We're putting in different biochemical signals that we hope the cells will respond to," Heilshorn said. "We're trying to make a biochemical home for the cells inside that lesion site."

Heilshorn is part of a team made up of Giles Plant, an associate professor of neurosurgery who is a pioneer in cell-based therapies for spinal cord injury, and Andrew Spakowitz, an associate professor of chemical engineering who is an expert in predicting polymer structures. Together, they are among the 22 teams that recently received seed grants from Stanford Bio-X to bring diverse minds to bear on complex biomedical problems.

"The seed grants are the special Bio-X glue that brings teams of faculty from all over the university to tackle complex problems in human health using new approaches," said Carla Shatz, the David Starr Jordan director of Bio-X and professor of biology and of neurobiology. "These grants are the heart of Bio-X's program, and have permitted us to build an incredible and robust network of over 600 interconnected faculty and students since they were first awarded in 2000."

Shatz, who is also the Sapp Family Provostial Professor, received a seed grant along with Christopher Garcia, professor of molecular and cellular physiology and of structural biology, to study how brain connections that are lost in Alzheimer's disease might be restored.

Like Heilshorn's work, each of the projects bridges two or more disciplines to create interdisciplinary teams of researchers. "Our project combines expertise in materials science and theoretical chemical engineering along with experience with spinal cord injuries," Heilshorn said. Together they have the expertise to understand a biomedical problem and generate novel approaches to solving it.

Provided by Stanford University