Researchers work toward ending cartilage loss

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Scientists have long wrestled with how to aid those who suffer cartilage damage and loss. One popular way is to inject an artificial gel that can imitate cartilage's natural ability to act as the body's shock absorber. But that solution is temporary, requiring follow-up injections.

Now Brown University nanotechnology specialist Thomas Webster has found a way to regenerate cartilage naturally by creating a synthetic surface that attracts cartilage-forming cells. These cells are then coaxed to multiply through electrical pulses. It's the first study that has shown enhanced cartilage regeneration using this method; it appears in the current issue of the *Journal of Biomedical Materials Research, Part A*.

"Cartilage regeneration is a big problem," said Webster, an associate professor in the Division of Engineering and the Department of Orthopaedics at Brown. "You don't feel pain until significant cartilage damage has occurred and it's bone rubbing on bone. That's why research into how to regenerate cartilage is so important."

Webster's work involves carbon nanotubes, which are molecular-scale tubes of graphitic carbon that are among the stiffest and strongest fibers known and are great conductors of electrons. They are being studied intensively worldwide for a range of commercial, industrial and medical uses.

Webster and his team, including Brown researcher Dongwoo Khang and Grace Park from Purdue University, found that the tubes, due to their unique surface properties, work well for stimulating cartilage-forming cells, known scientifically as chondrocytes. The nanotube's surface is rough; viewed under a microscope, it looks like a bumpy landscape. Yet that uneven surface closely resembles the contours of natural tissue, so cartilage cells see it as a natural environment to colonize.

"We're tricking the body, so to speak," Webster said. "It all goes back to the fact that the nanotubes are mimicking the natural roughness of tissues in the first place."

Previous research has involved using a micron surface, which is smoother at the nanoscale. Webster said his team's nanosurface works better than micron due to its roughness and because it can be shaped to fit the contours of the degenerated area, much like a Band-Aid.

The researchers also learned they could prod the cartilage cells to grow more densely by applying electrical pulses. Scientists don't completely understand why electricity seems to trigger cartilage growth, but they think it helps calcium ions enter a cell, and calcium is known to play an integral role in growing cartilage.

The team plans to test the cartilage regeneration method procedure with animals, and if that is successful, to conduct the research on humans.

Webster's cartilage regeneration studies parallel research he has done with bone regeneration and implants that was published last year in Nanotechnology. The principles are the same: Bone cells are more apt to adhere to a rough carbon nanotube surface than other surfaces and to colonize that surface. And tests by scientists in Japan and elsewhere have shown that electrical pulses stimulate bone cell growth.

Source: Brown University