Medical Xpress

# Making lab-grown tissues stronger

October 30 2014, by Andy Fell

Lab-grown tissues could one day provide new treatments for injuries and damage to the joints, including articular cartilage, tendons and ligaments.

Cartilage, for example, is a hard material that caps the ends of bones and allows joints to work smoothly. UC Davis biomedical engineers, exploring ways to toughen up engineered cartilage and keep natural tissues strong outside the body, report new developments this week in the journal *Proceedings of the National Academy of Sciences*.

"The problem with engineered tissue is that the mechanical properties are far from those of native tissue," said Eleftherios Makris, a postdoctoral researcher at the UC Davis Department of Biomedical Engineering and first author on the paper. Makris is working under the supervision of Professor Kyriacos A. Athanasiou, a distinguished professor of biomedical engineering and orthopedic surgery, and chair of the Department of Biomedical Engineering.

While engineered cartilage has yet to be tested or approved for use in humans, a current method for treating serious joint problems is with transplants of native cartilage. But it is well known that this method is not sufficient as a long-term clinical solution, Makris said.

The major component of cartilage is a protein called collagen, which also provides strength and flexibility to the majority of our tissues, including ligaments, tendons, skin and bones. Collagen is produced by the cells and made up of long fibers that can be cross-linked together.

# Engineering new cartilage

Researchers in the Athanasiou group have been maintaining native cartilage in the lab and culturing cartilage cells, or chondrocytes, to produce engineered cartilage.

"In engineered tissues the cells produce initially an immature matrix, and the maturation process makes it tougher," Makris said.

Knee joints are normally low in oxygen, so the researchers looked at the effect of depriving native or engineered cartilage of oxygen. In both cases, low oxygen led to more cross-linking and stronger material. They also found that an enzyme called lysyl oxidase, which is triggered by low oxygen levels, promoted cross-linking and made the material stronger.

"The ramifications of the work presented in the *PNAS* paper are tremendous with respect to tissue grafts used in surgery, as well as new tissues fabricated using the principles of tissue engineering," Athanasiou said. Grafts such as cadaveric cartilage, tendons or ligaments—notorious for losing their mechanical characteristics in storage—can now be treated with the processes developed at UC Davis to make them stronger and fully functional, he said.

Athanasiou also envisions that many tissue engineering methods will now be altered to take advantage of this strengthening technique.

**More information:** Developing functional musculoskeletal tissues through hypoxia and lysyl oxidase-induced collagen cross-linking, *PNAS*, www.pnas.org/cgi/doi/10.1073/pnas.1414271111

Provided by UC Davis