Stem cell innovation regrows rotator cuffs

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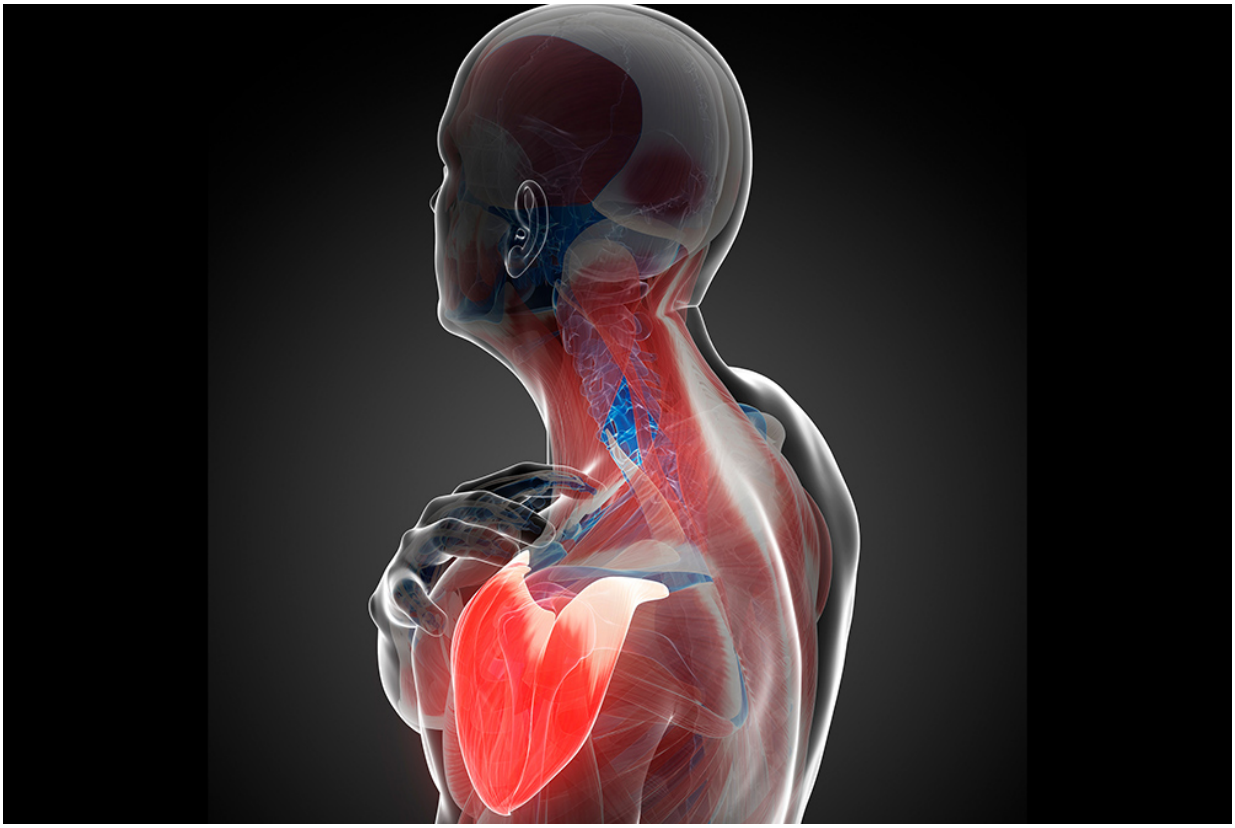

A team of researchers from UConn Health has found a way to regenerate rotator cuff tendons after they're torn, using a nano-textured fabric seeded with stem cells. Credit: Getty Images/University of Connecticut

Every time you throw a ball, swing a golf club, reach for a jar on a shelf, or cradle a baby, you can thank your rotator cuff. This nest of tendons connecting your arm bone to your shoulder socket is a functional marvel,

but it's also prone to tearing. Now, a team of researchers from UConn Health has found a way to regenerate rotator cuff tendons after they're torn and make a stronger repair.

Rotator cuff problems are common, with about two million people afflicted and about 300,000 rotator cuff repair surgeries every year in the US. Surgeons have many techniques to reconnect the tendon to the bone. The problem is that often they don't stay reconnected.

"Up to 60% of the time after surgery, there's a re-rupture," says Dr. Cato Laurencin, Van Dusen Distinguished Professor of Orthopaedic Surgery at UConn Health. And that means more surgery, or learning to live with reduced mobility in the joint. Orthopaedic surgeons struggle with this constantly. They would love to have a better way.

Laurencin and his colleagues report in the April 3rd issue of the journal *PLOS ONE* that they may have found one. Using a nano-textured fabric seeded with stem cells, they were able to get torn rotator cuff tendons to regenerate in animals. Not only did the tendons wrapped in the fabric make a better attachment to the bone, they were stronger overall, with a cell structure that looked more like natural, undamaged tissue. Tendons repaired with a purely surgical technique healed with a more disorganized cell structure, which made the tendon itself weaker.

The combination of the "nano-mesh" with stem cells seems to be critical. Surgeons will sometimes inject stem cells into rotator cuff repairs, but results from this technique are mixed. Stem cells alone don't necessarily stick around at the surgery site. Adding the mesh changes that. The mesh, made of a nanostructured polymer combining polylactic acid (PCL) and polyphosphazene (PNEAmPh)—pioneered in Laurencin's laboratory—provides an attractive habitat for the stem cells to hunker down. Once they settle into the rotator cuff location, the stem cells began sending out signals directing other cells to align and grow into tendon

tissue.

Images taken at six and twelve weeks in animals show that torn rotator cuff tissue reorganizes under the influence of the matrix and stem cells. Once the tendon is fully regenerated the polymer matrix can dissolve.

"We hope to use this technology to create new methodologies in rotator cuff repair," Laurencin says.

And if the polymer mesh plus stem cell technique proves durable in human rotator cuff tendons, Laurencin won't stop there. "Being able to regenerate complex soft tissues like the rotator cuff is an important step, but we have even bigger goals," Laurencin says.

Their results have already laid the groundwork for regenerating tendons in other joints, including the knee. His long-term project is called the Hartford Engineering a Limb Project or H.E.A.L. Funded by a National Institutes of Health Pioneer Award, an Emerging Frontiers Grant from the National Science Foundation, and grants from the state of Connecticut, his project aims to regrow entire joints and limbs. Working with a team of bioengineers, material scientists, surgeons and developmental biologists, Laurencin believes the ambitious goal can be achieved.

More information: *PLOS ONE* (2017). journals.plos.org/plosone/arti… journal.pone.0174789

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