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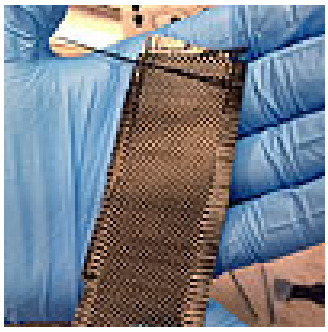

'Holy Grail' of Tissue Repair

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A University of Dayton bioengineering lab has advanced the search for the "holy grail" of tissue repair with a new design of carbon-based scaffolds that promote faster healing and offer greater function of injured tissue.

Most surgeons today use donated tissue (grafts) and synthetic tissue-like materials to repair torn tissue such as tendons, skin, muscles or even bone, said Jerry Czarnecki, a Ph.D. candidate in mechanical engineering. These grafts and scaffolds, however, often fail to provide the optimal combination of tissue function and regeneration while maintaining mechanical strength, he said.

Czarnecki said what is needed is what he calls the "holy grail" of tissue repair, a material:

- porous enough to facilitate new cell growth
- elastic enough to allow the healing tissue to stretch and function properly
- strong enough to maintain its structural integrity
- biocompatible enough to avoid rejection and toxicity.

Czarnecki developed two hybrid, carbon-based materials that have shown positive results for these factors in laboratory testing, particularly for soft tissues such as ligaments and tendons. The materials have a patent pending, and the findings of the study were published in *Tissue Engineering* in May as "Hybrid Carbon-Based Scaffold for Applications in Soft Tissue Reconstruction."

"This material is compatible with cell growth, structurally sound, and it can carry the function you want it to carry," said Khalid Lafdi, Wright Brothers Institute Endowed Chair in Nanomaterials at the University of Dayton, and the principal investigator of the study. "There is nothing out there like that."

In the tests, Czarnecki compared a "carbon fabric" and a "carbon veil" he developed to a commercialized synthetic graft derived from donated human tissue. Both carbon materials enabled cell-growth comparably to the synthetic graft, but they were stronger and more rigid, making them ideal for tendon repair.

In addition, the carbon fabric facilitated cell growth in a linear fashion, increasing the strength and durability of the new tissue.

"This is a material that is tunable — it can be adjusted for use in several applications — it degrades and is absorbed by the body, it is not apparently toxic, it is not expensive, and it has a long shelf-life," Czarnecki said. "This really is a new mode of healing."

The hybrid carbon materials will now move to *in vivo* testing at the University of Morocco.

The study is a strong example of multidisciplinary research, Lafdi said. He and Czarnecki collaborated with Panagiotis Tsonis, a biology professor and director of the University of Dayton's Center for Tissue Regeneration and Engineering at Dayton (TREND), and with medical doctor Robert M. Joseph, owner of Perspective Advantage Solutions in Dayton, who first approached Lafdi and Czarnecki to improve graft options.

The TREND Center is an Ohio Center of Excellence in the field of biomedicine and health care and includes a research alliance with Wright State University, the Kettering Medical Center Network, Rice University and others. Established in 2006, it has more than 20 researchers participating from six academic departments and the University of Dayton Research Institute. Center investigators maintain nearly $5 million in research contracts and grants, and have compiled more than 500 peer-reviewed articles.

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