HEALTH

Trying to Grow Strong Cartilage

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About 25 million U.S. adults suffer from osteoarthritis, a debilitating degeneration of the joints that can cause extreme pain and limit mobility. Cartilage, the thin, white connective tissue lining the ends of the bones, normally works as a cushion that redistributes stresses and reduces friction. But with osteoarthritis, it wears away. As a result, bones rub directly against each other. The problem is getting worse as the U.S. population gets older and heavier. (Extra weight puts more pressure on joints.)

Gerard Ateshian and his team are trying to understand how normal cartilage provides lubrication. That way, they can slow down the degeneration of the cartilage or come up with substitutes to repair worn joints. Cartilage is a highly hydrated tissue. In fact, nearly 90 percent of the cartilage located near the articular surface consists of water. This fluid pressurizes upon loading and supports most of the load transmitted across the joint. As a result, there is very little friction and wear of cartilage under normal conditions.

Traditionally lubrication has been an engineering topic. So this research, which applies engineering to a problem related to physiology, is a perfect marriage of engineering and medicine. The goal: to use tissue engineering techniques to grow artificial cartilage that's as strong and resilient as the native tissue, and equally able to reproduce low friction and wear.

In adulthood, the biological triggers that tell cartilage to regenerate are turned off. Therefore, human cartilage cannot restore itself once it has deteriorated in the joints. But fortunately, the body is unlikely to reject the lab-grown tissue since adult cartilage does not contain blood vessels.

As a result, it is unlikely that recipients of engineered cartilage would need anti-rejection drugs, providing a viable alternative to joint replacement surgery or debilitating pain. In collaboration with Clark Hung from biomedical engineering, Ateshian has applied insights gained from cartilage mechanics and lubrication studies to develop better and stronger engineered cartilage.

Ateshian is director of the Musculoskeletal Biomechanics Laboratory, which he founded in 1996. The lab's fundamental philosophy is that major scientific breakthroughs can be achieved in biomedical engineering by judiciously combining theoretical analyses with experimental studies. The lab's research efforts have expanded toward modeling of solute transport and growth processes in biological tissues, the development of computational tools that can address these mechanisms, and the extension of insights gained from musculoskeletal studies to cardiovascular tissues and reproductive cells.

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