Slick and springy: Research reveals protein's role in joints

April 6 2007

Synovial fluid is slime with a serious purpose: Protecting shoulders, hips and other joints from wear, reducing the likelihood of injuries and arthritis.

Scientists have long believed that synovial fluid gets its surface-slicking, shock-absorbing properties from the "goo molecule" hyaluronate. But new research led by Brown University physician and engineer Gregory Jay, M.D., shows that the protein lubricin is also a player, not only lubricating cartilage but also giving synovial fluid its spring.

"Protein components like lubricin are just as key as hyaluronate for protecting joints," Jay said. "What we hope to get out of this knowledge is better treatments for arthritis, one of the most common chronic health problems and the biggest cause of disability in the nation."

Jay's research, published online in the *Proceedings of the National Academy of Sciences*, is clinically relevant. People with osteoarthritis in their knees can now get viscosupplementation, a medical procedure that involves an injection of hyaluronate directly into knee joints in an effort to reduce pain and improve movement. The new research shows that it might be beneficial to add lubricin into these injectable fluids, Jay said.

"Adding this protein to supplements could restore elasticity in synovial fluid and prevent damage to cartilage inside the joint," he said. "These supplements could be an effective preventive treatment for arthritis or for sports injuries."

Jay, a Rhode Island Hospital emergency physician and Brown associate professor of emergency medicine and engineering, has studied joint mechanics for 20 years. His lab spearheaded research into lubricin's role as a "boundary lubricant" by reducing friction between opposing layers of cartilage inside joints.

In this new work, Jay and his team show how lubricin and hyaluronate work together to give synovial fluid its elastic property. The team found that these molecules act as weaver and wool: Lubricin gathers the long, thin, stiff polymers of hyaluronate together, creating structures that the researchers found create shock-absorbing structures inside synovial fluid.

To study this molecular interaction, researchers put microscopic, fluorescent beads into two samples of synovial fluid. One sample was normal. The other came from a patient whose body doesn't produce lubricin. This rare condition, called CACP syndrome, causes premature joint failure, often prompting the need for joint replacement surgeries for patients in their 20s.

Using a camera and a microscope, the research team observed how these beads moved through the fluid. Those movements were measured and – using a theory espoused by Albert Einstein – used to calculate viscosity and elasticity. The result: Synovial fluid that lacked lubricin wasn't elastic – and wouldn't be able to protect cartilage.

"Elasticity is distinct from boundary lubrication," Jay said. "It's a different protective feature."

Source: Brown University