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Researchers find stem cells in degenerating spinal discs, potential for repair

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Orthopedic researchers at Jefferson Medical College have for the first time found stem cells in the intervertebral discs of the human spine, suggesting that such cells might someday be used to help repair degenerating discs and remedy lower back and neck pain.

Reporting November 1, 2007 in the journal Spine, a team led by Makarand Risbud, Ph.D., and Irving Shapiro, Ph.D., at Jefferson Medical College of Thomas Jefferson University in Philadelphia, have found stem cells in both degenerated adult human discs and in discs of animals.

Many people suffer from lower back pain, and treatment ranges from painkillers such as acetominophen to medical procedures, such as fusing vertebrae. The combined annual costs for treatment of back pain and disc disease is approximately $100 billion a year and a major cause of lost work in the United States.

According to Dr. Shapiro, as the discs in the spine degenerate, cells are lost and the ability to produce water-binding molecules called proteoglycans is decreased. The water absorbs forces on the spine, essentially serving as shock absorbers. Losing proteoglycans can result in damage to the disc, and sometimes, pain.

“It would be wonderful if we could get the cells in the intervertebral disc to regenerate or increase the amount of proteoglycans that they synthesize,” he says. “That way we could regenerate the shock-absorbing

capabilities of the spine."

Dr. Risbud, an assistant professor of Orthopedic Surgery, and Dr. Shapiro, who is professor of Orthopedic Surgery, both at Jefferson Medical College, and their co-workers asked if it was possible to regenerate proteoglycans using adult stem cells. Federal regulations prevent them from using embryonic stem cells.

Dr. Risbud built the study around the observation that while the tissue that he could isolate from the disc was no longer binding water, the tissue still might contain dormant stem cells. He thought that while these cells were no longer functioning to repair the damaged disc, under appropriate conditions, they could be activated.

To explore that possibility, he isolated cells from discarded disc tissue that still had the capacity to proliferate. Dr. Risbud notes that under certain conditions, the cells could be encouraged to form bone. In other conditions, the cells would form cartilage or even fat. The tests proved that these cells were indeed dormant disc stem cells. "If we are able to stimulate the 'silent' cells in the patient, then it may be possible to repair the ravages of degenerative disc disease without undergoing invasive surgical procedures that may limit the motion of the spine," he says.

According to Dr. Risbud, in earlier work, the researchers found that local conditions in the disc can promote adult stem cells of the bone marrow to acquire characteristics of disc cells. Within the disc, the local conditions are unique in that the oxygen levels are low. These conditions cause the expression of many specialized molecules, including the water-binding proteoglycans. Some of the researchers' current experiments focus on the use of adult stem cells to repair the degenerate intervertebral disc.

Shapiro notes that other researchers have taken bone marrow stem cells

and have made new bone, cartilage and fat tissue. “Our next step is to activate these disc stem cells and get them to repopulate the disc and make proteoglycans and restore the water-binding,

The scientists theorize that because the stem cells exist in the degenerate disk, there may be molecules that are blocking stem cell activity. “Something is inhibiting the disc repair process,” says Dr. Shapiro. Drs. Shapiro and Risbud agree that “new studies are needed to discover the nature of such inhibitory molecules” and to find ways to block their activities, promoting natural healing.

Source: Thomas Jefferson University