News Bureau
UNIVERSITY of MISSOURI-COLUMBIA

Jul 10 2006

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Creating the Perfect Knee Replacement
MU Researcher Creates Custom, Biological Knees for Patients

COLUMBIA, Mo. - More than 400,000 people had total knee replacement surgery in 2003, according to the American Academy of Orthopaedic Surgeons. In a total knee replacement, all three components of the knee - the kneecap, femur and tibia - are replaced with artificial components. In every surgery, design of the implant, along with compatibility, must be considered before proceeding. University of Missouri-Columbia researchers are working to create a custom knee replacement using biological parts in an effort to avoid the complications of artificial knees. The project, funded by a $250,000, two-year grant from the National Institutes of Health, is a collaboration among James Cook, a professor of veterinary medicine and surgery at MU, and researchers at Columbia University in New York.

After using an MRI or CT scan to create a picture of the patient's current joint, Cook's team will create a computer-generated knee replacement specific to the patient's needs. In the current study, the patients are dogs who have degenerative knees. Then the MU researchers will send the scan, along with donor cells, to Clark Hung, a researcher at Columbia University, and his team will shape the replacement in a special mold based on the scans. After the new tissue is created, it will be trained to handle various kinds of impacts. This process will last about three weeks, and the new knee will be sent back to Missouri, where Cook will implant the biological, patient-specific, ready-to-be-used knee into the patient.

Along with potential rejection side effects, scientists currently cannot implant new tissue to fix certain damaged areas of the knee because the tissue is not conditioned to accept the pressure and pounding associated with normal movement of the knee. In such cases, the new tissue would not survive and would be destroyed shortly after being implanted. In addition, current technology with metal or plastic knee implants typically lasts for only 10 to 15 years before problems become noticeable, Cook said.

"The best a metal or plastic knee will ever be is when it is first placed inside the patient's leg," Cook said. "After that, it starts to deteriorate. The knee that we are attempting to create would have the ability to adapt and 'learn' what to do in within the patient's body. It's possible that the new knee will be better in ten years than it was when we first implanted it. This could have a lot of implications for human knee replacements in the future."

To date, Cook has completed the procedure with two dogs, and both

animals did well. The new knee implants were accepted by the body without any problems, and the cartilage looks normal, Cook said. Cook has identified 21 dogs who will receive the procedure during the current study.

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Published by the MU News Bureau
329 Jesse Hall, Columbia MO 65211
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