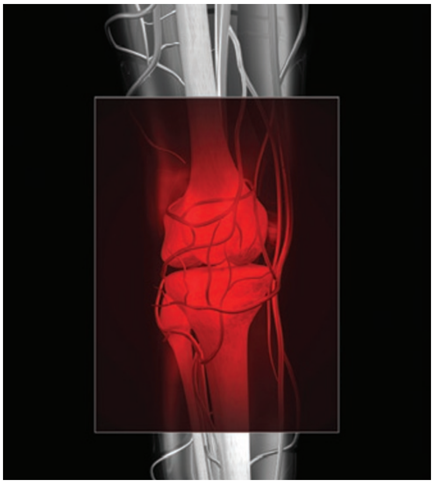
Engineered cartilage does better under pressure

Arthritis affects millions of people worldwide, causing pain and stiffness in joints. In some cases, arthritis develops after the cartilage in a joint is damaged. Cartilage acts to cushion the joints, allowing for smooth movement. Because cartilage cannot repair itself after injury, tissue engineers have attempted to generate new cartilage that could be transplanted into a damaged joint to repair it before arthritis can set in. However, it has proven difficult to create engineered cartilage with biomechanical properties similar to those of native cartilage. Several factors contribute to this difficulty. First, because cartilage doesn't heal naturally, engineers have no natural process to attempt to copy. Second, many of the biomechanical properties of cartilage (such as its stiffness and strength) are derived not from the cartilage cells themselves, known as chondrocytes, but from a dense mat of collagen and proteoglycans that is woven around them. This extracellular matrix (ECM) is formed during childhood.



Aaliya Landholt

But engineered cartilage has now made a leap forward. Tissue engineers at Rice University (Houston, TX) have created engineered cartilage with biomechanical properties that more closely resemble those of native cartilage. Benjamin Elder and Kyriacos Athanasiou isolated chondrocytes from the knees of male calves, engineered them to grow cartilage and then exposed the engineered cartilage to a combination of growth factors and hydrostatic pressure (*PLoS ONE* **3**, e2341; 2008). "The combination of hydrostatic pressure and growth factors used in this process results in an engineered cartilage ECM with properties nearly identical to those of native cartilage," said Athanasiou.

Most tissue engineering strategies try to simulate the conditions that cells are exposed to in the human body, so Elder and Athanasiou's approach is somewhat unconventional. During daily activities, native chondrocytes may experience pressures approaching the high levels used in Elder and Athanasiou's research, but only for short periods of time.

The techniques have not yet been tested in live animals or humans. But the researchers feel that their work holds promise for treating arthritis in the future. It may also be applicable to engineering other types of tissue to repair bladders, blood vessels, kidneys, heart valves and bones, according to Athanasiou.
Monica Harrington

MONKEYS MASTER 'MIND CONTROL'

In a study that brings to mind any number of science fiction films, researchers have taught monkeys to feed themselves using a robotic arm, controlled by the monkeys' brain power alone. This is the first experiment to demonstrate the use of a brain–machine interface for a practical task; until now such studies have been limited to moving a cursor across a screen. The results suggest that sophisticated prosthetic devices that can be controlled as naturally as normal limbs may one day be feasible for amputees and people suffering from paralysis.

Andrew Schwartz and colleagues of the University of Pittsburgh and Carnegie Mellon University (PA) implanted grids of microelectrodes in the brains of two rhesus macaques, in the region of the cortex known to control arm movement (*Nature*, published online 28 May 2008; doi:10.1038/nature06996). The electrodes transmitted monkeys' cortical signals, which were translated into the motions of a humanlike robotic arm.

The researchers trained monkeys to use the robotic arm to reach for a treat, grip it, bring it to the mouth and release it. To become familiar with the robot's movements, monkeys first learned to control it with a joystick. Monkeys' arms were then gently restrained so that they would not grab the food manually, and scientists taught them to manipulate the robot using their 'thoughts'. When training began, many of the robot's motions were automated, and this assistance was gradually reduced until monkeys controlled the arm independently.

Rapid computing of monkeys' brain signals enabled fluid and natural control of the prosthesis. Monkeys seemed to interact with the arm as if it were their own, discovering how to avoid obstacles and even uncovering certain features of which scientists were previously unaware (for example, certain gooey treats would stick to the arm, so monkeys didn't bother gripping them when retrieving them to their mouths). Additionally, monkeys seemed to carry out normal motor functions such as chewing and moving their heads without disrupting the motion of the machine.

There are still many challenges to overcome before such brain–machine interfaces are practical in humans. First, implantable electrodes are still unreliable for the long term; in fact, signal power in one of the monkeys in this study faded before the experiment's conclusion. In addition, the available technology for operating such devices is too cumbersome to transport. Still, despite these limitations, this proof-of-principle study suggests a bright future for human prostheses. **Karen Marron**