New biomedical device uses nanotechnology to monitor hip implant healing

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It is so small, you can barely see it, but a microsensor created by University of Alberta engineers may soon make a huge difference in the lives of people recovering from hip replacement surgery. The U of A research team has invented a self-powered wireless microsensor for monitoring the bone healing process after surgery--it is so tiny it can fit onto the tip of a pen.

"This microsensor not only reduces post-operation recovery time, it will also help reduce the wait time for patients needing artificial joint implants," says Dr. Walied Moussa, a professor in the Department of Mechanical Engineering.

During the healing process that follows joint replacement, bone grows and attaches to the pores on the surface of the implant creating greater fixation and stability of the joint. This process is known as osseointegration.

Using nanotechnology, the researchers built a device that measures and compares the relative osseointegration of a hip implant over time. The microsensor will be able to monitor the progression of the biological fixation between bone tissue and the implant.

The sensor is permanently implanted with the joint and is powered kinetically--it uses the natural movement of the patient's body as its power source. When it isn't being used, it stays dormant until a doctor asks it to start transmitting data.

Careful monitoring of how the patient is healing will help patients recover as quickly as possible and resume normal activities with less chance of over stressing the fracture during recovery and rehabilitation. It also allows the surgeon to more accurately decide when it is safe to send patients home from the hospital with their new implants.

"The ability to monitor and quantify this healing process is critical to orthopaedic surgeons in determining a patient's rehabilitation progress," says Moussa, who has a lab in the National Research Council's National Institute for Nanotechnology. "Until now, there has been no quantitative method for assessing osseointegration."

The device will also cut down the need for X-rays to monitor bone functionality, reducing costs and exposure to radiation. And the sensor can detect and identify bone less before it is even visible on a radiograph.

This technology will not only monitor bone healing at the time of surgery but also can determine when implants are worn out and need to be replaced. It will be valuable throughout the patient's lifetime for observing and maintaining the health of the implant. This research has the potential to transform biomedical practice with fascinating applications in artificial knees, hip replacement, and other joint therapy. Earlier this year, TEC Edmonton, a joint initiative of the U of A and Edmonton Economic Development Corp to advance technology transfer and commercialization, filed a provisional U.S. patent application for the work.

Source: University of Alberta