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# TTU Mechanical Engineering Students Seek to Improve Knee Replacements

by Jerry Renshaw

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A team of Tennessee Tech University mechanical engineering students is working to make knee replacements last longer and work better to enhance patients' lives after surgery.

Knee replacements are the second most common orthopedic procedure in the United States, and one of the most trouble-prone – only one in five knee replacement recipients are satisfied with their pain level and mobility a year after the surgery.

April Parkison, of Kingston, Tennessee, and Cesar Contreras, of Mount Juliet, are at the center of this effort, building on work done by graduate student Brooke Wilson, of Cookeville. April and Cesar were awarded TTU undergraduate research grants to continue their research next semester.

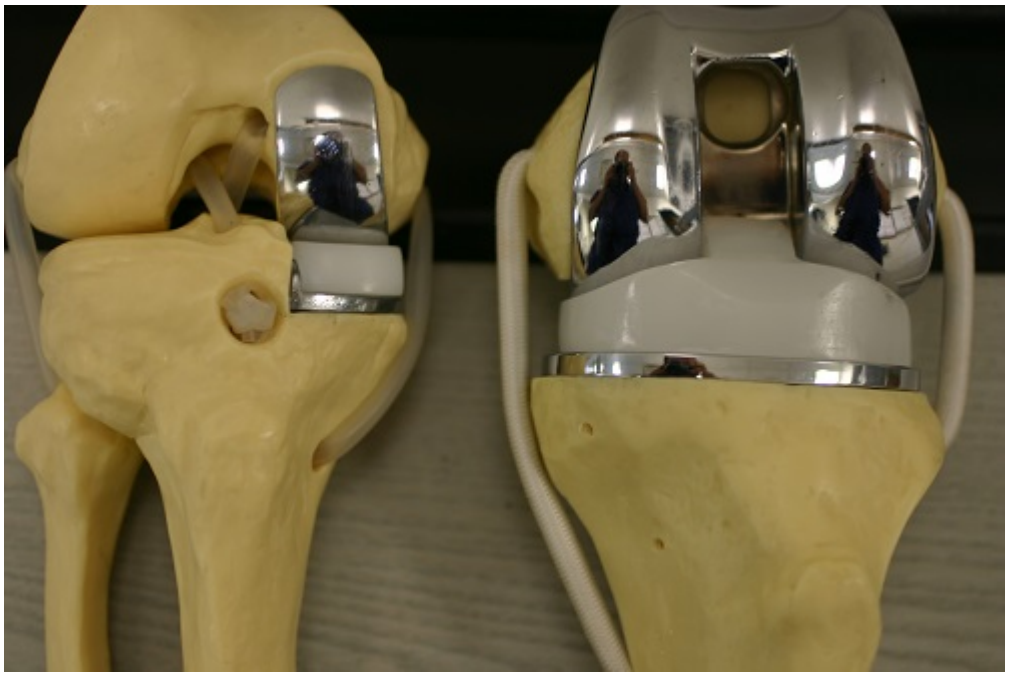

**Photo courtesy of totalknee.org** (http://www.totalknee.org/)**. The model on the right is a full replacement -- PZTs would be embedded in the polyethylene.**

Successful knee replacements depend on variables including a patient's weight, gait, lifestyle and activity level.

Attaching ligaments to the replacement knee is one of the most difficult parts of the surgery, but doing it correctly is essential to the service life of the implant. Often, surgeons rely on experience and their intuition to finish those connections.

Parkison and Contreras are using piezoelectric stacks, a device that can sense forces in the knee and give the surgeon feedback during the operation and as the knee heals. The stacks will be used to harvest energy to power an embedded sensor inside the implant.

*"A piezoelectric stack bridges the gap between the mechanical domain and the electrical domain,"* said Parkison. *"We fit them into a type of polyethylene that's used as a replacement for cartilage. In this case, they're energy harvesting devices and sensors that can help a surgeon with the minute measurements involved in ligament balance."*

The students' research involves wedging the devices between two pieces of polyethylene and subjecting them to testing in a load frame. The testing determines the voltage and power output of the PZTs as well as the stress and fatigue on the polyethylene.

The team members say they hope the devices can help monitor the structural health of the implant for years after the surgery. The devices can be used with a low-power circuit to send a wireless signal to give information on the implant's condition.

Experimental sensors that work on magnetic fields have also been developed, but they make it difficult for a person to walk normally. The research at TTU is centered on whether the devices can generate enough power to without impeding a patient's gait.

*Last edited **2014.12.10** by **Davis, Cynthia**.*