Clemson University Research Foundation

Locking Total Knee Replacement Design for Treating Knee Extensor Weakness (2012-084, 2013-058)

"Lock-key," Patient Controlled Mechanism for Knee Replacement Allows Ambulation

Market Overview

This design allows patients to selectively lock the knee in full extension for the purposes of ambulation and unlock free rotation when desired. According to the American Academy of Orthopedic Surgeons, over 600,000 total knee replacement surgeries are performed in the United States each year. While total knee replacement (TKR) is a definitive method to restore knee function in most patients, some have trouble with knee function and weakness following surgery. Knee arthrodesis is required when a patient has inadequate muscular control or soft tissue stability to ambulate. This extended position requires greater muscular strength and endurance to control, even when sitting, which leads to secondary joint pain and muscular fatigue. The permanence of such a position can also prevent patient participation in many activities of daily living. Clemson University researchers developed a new design that provides an alternative surgical treatment to arthrodesis. This design enables a patient controlled locking mechanism within a TKR that can allow for bending of the knee joint when necessary. This provides functional convenience for patients, allowing them to flex their knee joint as necessary during passive functions and to walk with the functional equivalence of arthrodesis.

Application

Reconstructive knee surgery; Alternative treatment

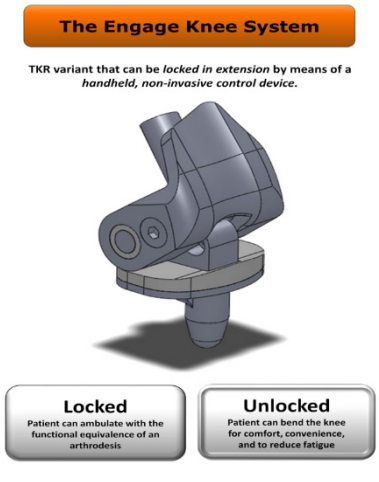
Stage of Development

Validated Prototype

Advantages

- TKR variant with a non-invasive, handheld, user controlled extension lock, addressing knee dysfunction and arthrodesis complications
- Modular design to fit in existing platform TKR designs, providing simple incorporation of new technology
- Ability to lock the knee in extension, reducing the magnitude of the compressive joint reaction force and resulting in near-complete reduction of quadriceps forces

Technical Summary



The proposed design is a variant of a stabilized total knee replacement used for reconstructive surgery. The device is predicated on hinged knee designs, but incorporates novel features that allow the user to selectively activate and deactivate a latch that locks the device in a position of full extension. The latch incorporates magnets, which allow the user to actuate the latch using an externally applied magnetic field, such as a handheld magnet. The latch is robust enough to resist bending at physiologically relevant loads. This allows the user to walk with a stiff leg gait when the device is locked in full extension. When the user unlocks the device, the user is able to flex the knee as desired or necessary. This reduces the movement of the leg when sitting or lying, increases mobility, and eliminates pain secondary to knee fusion, ultimately solving the problem of terminal knee extensor mechanism weaknesses that traditionally prevent patients from ambulating.

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About the Inventor

Dr. John DesJardins is an Assistant Professor of Bioengineering at Clemson University. He earned his Ph.D. in Bioengineering from Clemson University and possesses over 20 years of experience as a biomechanical research engineer. He currently serves as the director of the Laboratory of Orthopedic Design and Engineering at Clemson University as well as the Frank H. Stelling and C. Dayton Riddle Orthopaedic Education and Research Laboratory at CUBEInC. Dr. DesJardins holds two issued patents and several U.S. and foreign applications. His research interests focus on total joint replacement, orthopaedic biomechanics, and biomaterials.

For More Information

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Application Type	Country	Serial No.	Patent No.	CURF Reference No.	Inventors
Utility	United States	13/944/161	9,072,606	2012-084 2013-058	Eric Lucas, John DesJardins, Kim Chillag