Prosthetic knee simulator replicating all knee motions (14 degrees of freedom) with full range of motion

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Technology description

Technology

Prosthetic implant failure mechanisms are numerous. When an implant fails either due to loosening, infection, or dislocation, patients may endure severe pain and require surgical revision. Wear failure, particularly in regards to materials, is often due to the generation of debris which has been shown to incite an inflammatory biological response leading to localized periprosthetic bone loss. Consequently, debris generation becomes a main factor in determining the life of the implant. Thus, along with biocompatibility, friction and wear are the most important aspects responsible for determining the clinical longevity of implants. The use of preclinical testing and validations are a critical step in the development of new designs. A critical component of preclinical testing and validation is an evaluation of the wear performance of the implant design through the use of simulators that mimic the physiological loadings and movements. These machines, known as either hip joint or knee joint simulators, test the implant through a large number of physiological motions and provide important data regarding the expected behavior of the implant in clinical use.

However, current simulator machines provide only a rough approximation of the complexity of human joint motion, such as knee motion. Hence there is a need for simulators that take into account various aspects of the implant design as well as aspects of the interactions of the implant with surrounding tissue. The inventors have described in this disclosure a prosthetic knee simulator that replicates 14 physiologic motions of the human knee joint, including, axial motion, flexion-extension, internal-external rotation, anteroposterior translation, mediolateral translation, valgus rotation and sagittal angular motion of the tibia. The design now also includes the shear forces acting on the tibial plateau thus enabling a more accurate analysis of the wear properties of the knee prosthesis. A unique aspect of this simulator design is a “Ball-Plate” mechanism, capable of controlling the internal-external rotation, valgus rotation and sagittal angular motion of tibia at the same time. In physiologic knee motions, a maximum 145o flexion and 10o extension are needed, which are now enabled by the design of this simulator.

Opportunity

This simulator would be used in the large orthopedic medical devices market which by some estimates will reach USD 43.1 billion by the year 2024. Simulators are used by contract research organizations, research institutions, and large orthopedic companies to validate and test orthopedic implant designs.

Rowan University is looking for a partner for further development and commercialization of this technology through a license

Application area

Research, development, and preclinical testing of new orthopedic devices.

Institution

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