SPECIFIC AIMS

Introduction. The rate of knee injury in sports is from 15-50%. About 45,000 high school athletes tear their anterior cruciate ligament each year. The prevalence of knee osteoarthritis is about 6% of adults and is five times more likely after a self-reported knee injury. Knee injury or disability is one of the top five diagnoses leading to medical separation from the military. An important consideration is dynamic function of the knee which may be quantified by biomechanical studies. Kinematic studies *in vivo* and in the cadaveric knee and have demonstrated differences between the intact, ligament injured, osteoarthritic, and reconstructed states. These studies have shown that the two dimensional models (four bar linkage theory, Burmeister curve) do not account for the measured motions. The best biomechanical description of three dimensional dynamic knee function remains unclear. Currently, there is no unifying theory or measurement to account for the different knee kinematics observed between the intact, ligament injured, osteoarthritic, and reconstructed states. We have shown that the helical axis of motion is a three dimensional concept that provides a more accurate description of knee motion. A better understanding of knee kinematics is important to improve knee reconstruction, knee rehabilitation, and design of total knee endoprostheses.

Hypothesis. **Our hypothesis is that the helical axis of motion, calculated from direct measurements in the continuously loaded, cadaveric human knee, provides the optimal biomechanical description of knee function and a derivation of the helical axis is a constant for the intact state and provides a unique description for different specific ligament injuries.**

Aims.

1. We will measure the translations and rotations in the continuously loaded human cadaveric knee using an eight degree of freedom jig using loads corresponding to the *in vivo* state. The measurements will be made in different conditions: intact, cruciate ligament transected (anterior cruciate and posterior cruciate), cruciate ligament reconstructed, total joint arthroplasty.

2. We will calculate the helical axis of motion from the measured translations and rotations for each condition.

3. We will compare the helical axis of motion between each condition. A derivation of the helical axis will be determined mathematically for each condition.

The study will demonstrate that the helical axis of motion is the optimal description of knee biomechanics. The helical axis of motion may be used to restore normal knee motion by improved rehabilitation, reconstruction, and endoprosthetic design.