NATIONAL INSTITUTE OF GENERAL MEDICAL SCIENCES, PHYSIOLOGY AND BIOMEDICAL ENGINEERING PROGRAM*

Americo Rivera, Ph. D., Program Administrator

The Dynamics of EMG-Force-Movement Relationships

Regular Grant: 5 R01 GM 26395
Rancho Los Amigos Hospital
Downey, CA 90242

Jacquelin Perry, M.D., Principal Investigator

The investigator will develop and validate mathematical models of electromyographic (EMG) force relationships associated with the extension of the human knee, using both experimental and analytical methods. The data acquisition systems have been completed and tested. The group proposes to provide standardized methodology for quantitative electromyography while obtaining the data needed for development of mathematical models. Other basic studies will be concerned with comparison of electrodes, the effects of muscle fatigue, periarticular tissue resistance, and antagonistic muscle activity.

The Mechanics of Human Bone and Long Bones

Regular Grant: 1 R01 GM 28827
Stanford University
Stanford, CA 94305

Robert L. Piziali, M.D., Ph. D., Principal Investigator

The investigator proposes to provide an accurate model of the elastic, plastic, and failure characteristics of the diaphysis of the human tibia and/or femur. He will use very general concepts and data reduction to formulate the models. Simplifications will then be imposed, and the errors resulting from these simplifications will be evaluated.

The year's work has permitted the investigator to settle on a particular isotropic model and given him the characteristics of the bone samples needed to provide the appropriate compression data.

The importance of circumferential lamellar bone in whole bone response will be established, along with its material properties. In addition, histological studies will be done to establish the distribution of circumferential lamellar bone throughout cross sections along the length of bones.

Control Systems for a Multi-Joint Prosthetic Arm

Regular Grant: 2 R01 GM 23499
University of Utah
Salt Lake City, UT 84112

Stephen C. Jacobsen, Ph.D., Principal Investigator

The goal of the project is to demonstrate the feasibility of activating a 4-DF (degrees of freedom) electric arm with the myoelectropotentials generated by the contractions of the amputee's remnant shoulder and stump musculature, amplified and processed by a controller.

The group has completed the series of 7-DF equations necessary to describe the movements of a normal arm. These are now to be used for a controller to drive 3 motions of a 4-DF myoelectric arm for an above-elbow amputee: rotating the forearm about the humeral axis, raising or lowering the forearm, and rotating the wrist and hand. The fourth motion, closing or opening the fingers of the terminal device, will be controlled independently by cable or by conventional myoelectric control.

The control system will be refined through extensive evaluation not only by computer in the laboratory but eventually in portable, wearable form in the amputees' home, work, and recreational environments.

Polyethylene Behavior in Joint Replacements

Regular Grant: 1 R01 GM 28829
Massachusetts Institute of Technology
Cambridge, MA 02139

Robert M. Rose, Sc. D., Principal Investigator

The investigator proposes to categorize the reasons for the behavior in vivo of ultrahigh-molecular-weight polyethylene (UHMWPE)—a material that is extensively used in total joint prostheses of the knee and hip—and to develop substantially improved versions of this material.

The group has found severe wear to be associated with certain key features in the structure of UHMWPE and its history. Contrary to current clinical notions, acrylic cement debris is not responsible for excessive wear of the UHMWPE devices. Under this project, the investigators propose to develop a series of UHMWPE specimens with superior properties; to make preliminary evaluations of wear resistance; and then, by total joint simulation, to test total joint components for relative fatigue resistance as a function of stress intensity. Nondestructive technologies will be developed to monitor the structure of UHMWPE to ensure consistent prosthesis performance.

Head/Neck/Upper Torso Mechanics

University of California
Berkeley, CA 94720

Werner Goldsmith, Ph.D., Principal Investigator

The investigator proposes to construct physical and mathematical models of the human head, neck and upper torso, including representations of major organs, vessels, ribs and muscle, to study their impact dynamics. The group proposes to develop both models simultaneously and compare them. It is anticipated that the data obtained from these completed models will provide a means to evaluate protective devices for the human body.

* Leo H. von Euler, M.D., is the Acting Director. W. Sue Badman, Ph. D., is the Chief, Biomedical Engineering and Instrument Development Section. NIGMS is located at Bethesda, Maryland 20205.