New Biomedical Research Enhances Military Surgical Training

Grant funds open tissue database and models for simulation

"Knowledge is not power. The sharing of knowledge is power," notes Douglas Merrill, a contributing writer at Forbes. His insight emphasizes the importance of sharing knowledge and data in today's technology-driven world.

Collaboration is especially critical in healthcare where new discoveries and innovations occur each day. Sharing data helps maximize the value of the initial research and technology investment. This trend is the driving force behind a new project at Cleveland Clinic aimed at developing an openly accessible virtual tissue database and models for simulation that will enhance training for military surgeons.

"In biomedical research, computational models are so valuable because they can be reused by numerous individuals in the scientific and clinical communities," explains Principal Investigator Ahmet Erdemir, PhD, of Cleveland Clinic's Department of Biomedical Engineering. "The models and research we're developing will be freely available to physicians, allowing them to focus on solving their clinical problems and further advancing the field of medicine."

Project funding and deliverables

The tissue database project began in September 2015. It is being funded by a three-year, $3.6 million grant from the U.S. Army Medical Research and Materiel Command (U.S. Department of Defense).

Dr. Erdemir and his team will conduct the experimentation and model development. They will collaborate with Cleveland Clinic's Center for Multidisciplinary Simulation and Simbios, an NIH National Center for Physics-Based Simulation of Biological Structures.

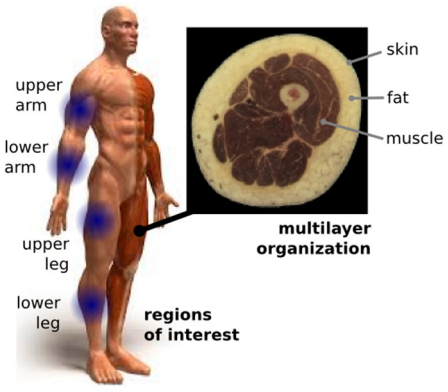

Figure 1. Target regions of interest in the upper and lower legs and arms covered by multilayer tissue structures.

Project deliverables include fundamental data, an open database of tissue mechanical and anatomical properties and virtual models of multilayer tissue structures of musculoskeletal extremities.

Data and models enable authentic simulation

While leaders in the biomedical field have the hardware and software needed to simulate some organ and tissue functions, they lack comprehensive data and the virtual models required for simulations of skin, fat and muscle layers of musculoskeletal extremities. These models must be shared, reused and customized to be beneficial in various surgical applications.

Virtual models allow physicians in training to experience the formations and mechanical forces generated by cutting or pushing against various parts of the human body. To create authentic models, researchers must collect, analyze and simplify extensive data related to the skin, fat and muscle layers. The simplified surrogate models are computationally efficient yet physiologically realistic enough to allow real-time simulations.

"Capturing authenticity is a key component of surgical training," says Dr. Erdemir. "During training, you need to convince the physicians that what they are experiencing is as close to what they will encounter in the field."

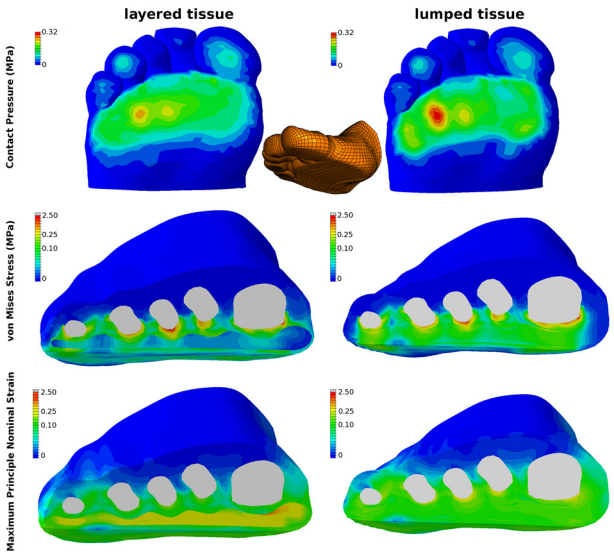

Figure 2. Finite element analysis of the mechanics of skin, fat and muscle layers of the forefoot, part of previous work by Dr. Erdemir and his team (Petre et al., J Biomech Eng, 2013).

Importance of simulation training in military applications

Surgical simulation is a cost-effective method of exposing military physicians to various conditions prior to deployment. Simulation training helps prepare them to act quickly and operate in the field under challenging circumstances. This project will develop models that simulate tissues in the arms and legs, which are difficult to protect and frequently injured in combat.

Extended benefits and collaboration

Beyond military applications, the openly accessible tissue database and simulation models will be available to train new or inexperienced surgeons from numerous disciplines around the world. The virtual models may even be used to test the skill level of surgeons who are applying to join a new medical team.

Even at these early stages of research, Dr. Erdemir wants to publicize the expectations for the project to Cleveland Clinic and beyond. "If the scientific and medical communities anticipate the benefits of the data and models we will produce, they will find new ways to apply them in their own biomedical research," he explains. "This will maximize the value of our project and promote collaboration with other clinicians and scientists."

Dr. Erdemir is planning to expand the staff of the tissue database project this year. For more information about the project, contact Dr. Erdemir at _____.

Excerpt Description: blog landing page teaser	Data sharing is critical to biomedical research. Cleveland Clinic is developing an open tissue database and models for military surgical training, with potential multidisciplinary applications.
Facebook post:	New biomedical research will help train military physicians to perform operations on musculoskeletal extremities in the field.
Tweets:	Find out how new biomedical research will enhance surgical training for military physicians—and beyond. New biomedical research project promotes collaboration and data sharing with multidisciplinary benefits. Discover how new biomedical research will save military surgeons an arm and a leg in training costs.