Development of A Medical Device for Quantitative Physical Therapies

Hansong Zeng, Furqan Haq, Thomas Best, Sudha Agarwal, Tim Butterfield, and Yi Zhao
The Ohio State University, Columbus, Ohio, 43210 USA

Physical therapies using mechanical loadings are widely used for improving and recovering the physical activities of human tissues. It is generally accepted that such therapies promote health and well-being by many mechanisms, including fastening muscle blood flow, parasympathetic activity, releasing relaxation hormones and inhibiting muscle tension, neuromuscular excitability and stress hormones. Nonetheless, most of current research in this area is based on statistics and thus qualitative, preventing the in-depth study of the effectiveness of these therapies. It is partially due to the lack of appropriate tools for quantitative loading and *in situ* tissue evaluation. To address this, we developed a medical device that resembles the mechanical motions and loadings that occur in massage therapies by applying combinations of compressive and shear loadings to the subject tissues. This device consists of a loading wheel, a force sensor, a pneumatic actuator, a control system and a data acquisition system. In this work, mechanical forces were applied to the lower limbs of rabbits with controllable magnitudes, frequencies and durations. The changes of mechanical properties of the subjects, including the compliance and the viscosity, were *in situ* measured as a function of the loading dose, and correlated to the results from biomolecular assay. This device can quickly identify the optimal sets of loading parameters which lead to high effectiveness, and thus provide guidance to practitioners to design their therapies. It is also expected to shed light on the fundamental study of biomechanical forces in regulation of the physiologic conditions of cells and tissues.