The Maurice A. Biot Lecture

Department of Civil Engineering and Engineering Mechanics
Columbia University

Functional Tissue Engineering: The Role of Biomechanics in Cartilage Tissue Engineering

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Inter-school Lab, CEPSR

Articular cartilage is the load-bearing tissue within all freely moving joints of mammals, *i.e.*, the diarthrodial joints such as hips, knees, shoulders, etc. These joints have remarkable tribological characteristics that are superior to most man-made bearings. Failure of this tissue leads to arthritis, a major biomedical problem. It is a hierarchical material with specific ultra-structural and micro-architectural features that spans 8 decades of dimensional scale. It has been established from basic biochemistry studies that the nano-scale structures of glycosaminoglycan and tropo-collagen molecules at the 10^{-9} to 10^{-8}m form important interactions in determining the physical and mechanical properties of the tissue. At two orders of magnitude up, from 10^{-7} to 10^{-6}m, i.e., at the ultra-scale level, the physical interactions resulting from the complex organizations of the proteoglycans and collagen network are important in determining the cohesiveness and strength of the porous-permeable matrix. At higher micro- and meso-scales, 10^{-5} to 10^{-3}m, interactions between cells and their extracellular matrix are important in the mechano-transduction of mechanical and physical signals that modulate the biosyntheses and organization of this tissue; these constituents form the tissues that must function within our bodies at the macro-scale, e.g., hips, knees, shoulders, etc. In mechanical and physical terms, articular cartilage is a charged-hydrated tissue with a strong, porous-permeable, fiber-reinforced matrix. These qualities endow the tissue with a panoply of interesting mechanical and physical characteristics that provide the underpinning necessary for the understanding the most important biological problem of the day, ie, mechano-signal transduction in cells and tissues. This lecture will describe the fundamental mixture theories, and experimental studies, necessary to study the mechano-electrochemical events generated when this tissue is loaded.

Past Speakers

2005: Prof. James R. Rice, Harvard University
Biot Poromechanics in Earthquake and Faulting Phenomena
2004: Prof. Stephen C. Cowin, City University of New York
Strain Amplification in the Mechanosensory System in Bone

About The Speaker

Prof. Van C. Mow graduated with a BAE in Aeronautical Engineering (1962) and a PhD in Applied Mechanics and Applied Mathematics (1966) from the Rensselaer Polytechnic Institute. After a brief period of postdoc and industrial experience at the Courant Institute of Mathematical Sciences, NYU, and Bell Telephone Laboratories, he joined the faculty of RPI in 1969 as Associate Professor in the Mechanics Department and rose to the rank of the Clark and Crossan Professor of Engineering in 1982.

In 1986, Prof. Mow relocated to Columbia University as the Anne Y. Stein Professor of Mechanical Engineering and Orthopaedic Bioengineering, and Director of the New York Orthopaedic Hospital Research Laboratory at Columbia College of Physicians and Surgeons. Here he developed and directed a research and teaching program in orthopaedic research. Today, he has published over 700 papers, edited 7 books and delivered more than 475 keynote, plenary and meeting lectures world wide.

Prof. Mow has received numerous honors for his contributions to biomedical engineering, including Fellow of ASME (1979), American Academy of Orthopedic Surgeons Kappa Delta Award (1981), ASME Melville Medal (1982), ASME HR Lissner Award (1987), Giovanni Borelli Award of the American Society of Biomechanics (1991), Alza Distinguished Lecturer (1994), ASME RH Thurston Lectureship (1998), the Ray Kroc Award for Arthritis Research (twice), and election to the National Academy of Engineering, the Institute of Medicine of the National Academy of Sciences (1998), and Academia Sinica of Taiwan (2004). He is also the recipient of 6 honorary professorships in China and one in Hong Kong. To honor his achievements, ASME and its Bioengineering Division have created the Van C. Mow Medal for Bioengineers, an annual award to be given to outstanding bioengineers at mid career for those who have displayed qualities of excellence in mentorship, excellence in research in biomechanics, and leadership in the profession.

The Maurice A. Biot Lecture was established at Columbia University in remembrance of the late Prof. Maurice Anthony Biot and his renowned achievements as an engineer, physicist, and applied mathematician. Biot was a professor of mechanics at Columbia University in the period 1937-1945.

Columbia University - The Organizer for *Fourth Biot Conference* in 2009
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