



## Reconstructing Cartilage

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In recent times, degenerative joint diseases, low back pain, cardiovascular diseases, osteoporosis, and sports injuries have become the focus of biomedical engineering. An overwhelming number of people today suffers from one or more of these clinical problems. As the average age of our population increases, this group of clinical diseases will affect an ever-increasing percentage of the population, worldwide.

The detailed understandings of this group of diseases have been, and are being successfully addressed by bioengineers using advanced engineering methodologies and mathematics. By far the largest subgroup of the family of diseases known as arthritis is degenerative joint disease (osteoarthritis), and it has attracted engineers to study this medical problem. Indeed, engineers have been successful in developing laws that govern the fundamental stress-strain behaviors of articular cartilage (the soft lining covering the bony ends in a joint). This tissue is the major constituent of joints (hip, knee, shoulder, intervertebral disc, meniscus, etc).

“After more than 35 years of concentrated efforts by bioengineers, we now have detailed knowledge on how tissues such as articular cartilage are formed biologically by chondrocytes (cartilage cells), deform under heavy and rapid joint loading, and fail,” said Van C. Mow. “Failure of articular cartilage as a bearing material of our joints always leads to osteoarthritis.”

Based on this relatively recently gained engineering knowledge, engineers are learning how to influence the cartilage cells to form and shape cartilage within joints, repair the damaged cartilage, and, in general, make the cartilage stronger against the natural wear and tear processes that often result from the activities of daily living, or from extreme loads, such as performing competitive sports.

Currently Mow’s lab is developing new models to understand how cartilage cells receive signals (mechanical, electrical, and chemical) to maintain tissue health and to stimulate the cellular repair processes to mend the micro-damages on and in the cartilage that result from excessive and repetitive loading.

Mow, a member of the National Academy of Engineering, the Institute of Medicine of the National Academy of Sciences, Academia Sinica of Taiwan, and the Academy of Sciences for the Developing World, is the founding chair of Columbia Engineering’s Department of Biomedical Engineering. He has served as professor of mechanical engineering and orthopedic bioengineering, director of the New York Orthopedic Hospital Research laboratory at Columbia University Medical Center, and is currently director of the Liu Ping Laboratory for Functional Tissue Engineering.

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