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Pronunciation: mahr yoh L-EYE-N (please note the 'soft' J)

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The skeleton is a load bearing structure, like many common man-made structures. However, unlike metals and other inert materials, bone tissue is a living organ composed of cells in mineralized matrix. These cells create the tissue and enable the structure to respond to a variety of genetic and epigenetic factors. One of the primary epigenetic regulatory factors is the mechanical environment, the stresses and strains, to which the skeleton is subjected during daily activities.

Traditionally, biomechanics has focused on examining the material and structural properties of living tissues, both in their normal and diseased states. This approach is primarily one of mechanics and is relevant to understanding the load bearing ability of tissues. Dr. van der Meulen?s work in this area focuses on understanding the role of tissue mechanical behavior on skeletal structural performance, as well as the role of particular tissue constituents (growth factors and other matrix molecules) on whole bone function.

Recently, interest has refocused on the other role of mechanics: understanding how mechanical forces influence skeletal structure. This new area has been termed ?mechanobiology? to emphasize the modulation of biological processes by mechanical stimuli. This area is of particular interest to Professor van der Meulen, and her laboratory works extensively on in vivo models of skeletal adaptation to mechanical stimuli and methods to assess this adaptation.

Current Projects

- Loading overcomes osteopenia from sex hormone withdrawal (NIH/NIA)
- Role of microstructure in nanomechanical behavior of bone tissue (NIH/NAIMS)
- FT-IR microscopy of mineral structure in osteoporosis (PI: Boskey, HSS, NIH/NIAMS)
- Multi-keV x-ray microscopy facility for bio-imaging (PI: Pianetta, SSRL, NIH/NIBIB):
  see tomography video featuring Beamline 6-2@SSRL
- The effects of mechanical compression on fracture healing
- Enhancing bone formation in compromised cancellous bone (PI: Bostrom, HSS, OREF)
- CU-ADVANCE Center (Co-Investigator, NSF-funded)

Selected Publications

Gourion-Arsiquaud S, Burket JC, Havill LM, DiCarlo E, Doty SB, Mendelsohn R, van der Meulen MC, Boskey AL
"Spatial variation in osteonal bone properties relative to tissue and animal age," *J Bone Miner Res* 24: 1271-1281, 2009

MAE Research Areas:

mechanics of biological materials

computational mechanics

solid mechanics

more about MAE Research Areas

MAE Research Programs:

Mechanics of Materials

Biomechanics

more about MAE Research Programs

Cornell Graduate Field Affiliations:

Mechanical Engineering

Aerospace Engineering

Biomedical Engineering

Computational Biology

more about Cornell Graduate Fields

Cole JH, Dowthwaite J, Scerpella TA, van der Meulen MCH
"Correcting fan-beam magnification in clinical densitometry scans of growing subjects," *J Clin Dens* 12: 322-329, 2009

Phillips JA, Almeida EA, Hill EL, Aguirre JI, Rivera MF, Nachbandi I, Wronski TJ, van der Meulen MC, Globus RK.
"Role for beta1 integrins in cortical osteocytes during acute musculoskeletal disuse," *Matrix Biol* 27: 609-18, 2008

Fritton JC, Myers ER, Wright TM, van der Meulen MCH
"Bone mass is increased and cancellous architecture altered due to cyclic loading of the mouse tibia after orchidectomy," *J Bone Miner Res* 23: 663-671, 2008

Donnelly E, Williams RM, Downs SA, Dickinson ME, Baker SP, van der Meulen MCH
"Quasistatic and dynamic nanomechanical properties of cancellous bone tissue relate to collagen content and organization," *J Mater Res* 21: 2106?2117, 2006

van der Meulen MCH, Morgan TG, Yang X, Baldini TH, Myers ER, Wright TM, Bostrom MPG
"Cancellous bone adaptation to in vivo loading in a rabbit model," *Bone* 38: 871?877, 2006

Fritton JC, Myers ER, Wright TM, van der Meulen MCH
"Increased mineral content in the proximal metaphysis after axial compression of the C57BL/6 mouse tibia," *Bone* 36: 1030-1038, 2005

Boskey AL, van der Meulen MCH, Wright TM
"Editorial: Guidelines for describing mouse skeletal phenotype," *J Orthop Res* 21: 1-5, 2003

Bailón-Plaza A, van der Meulen MCH
"Beneficial effects of moderate, early loading and adverse effects of delayed or excessive loading on bone healing," *J Biomech* 36: 1069?1077, 2003

van der Meulen MCH, Huiskes R
"Why mechanobiology? A survey article," *J Biomechanics* 35: 401?414, 2002

van der Meulen MCH, Jepsen KJ, Mikic' B
"Understanding bone strength: size isn't everything," *Bone* 29: 101-104, 2001

Biography

Before joining the faculty at Cornell, Marjolein van der Meulen worked as a biomedical engineer at the Rehabilitation R&D Center of the Department of Veterans Affairs, in Palo Alto, California. She joined the VA after completing her MS and PhD at Stanford University with Professor Dennis Carter and SB at MIT, all in mechanical engineering. As a graduate student she received a NASA Graduate Student Researchers Program fellowship and conducted her experiments at NASA Ames Research Center with Dr. Emily Morey Holton. In 1995, Prof. van der Meulen received an NIH FIRST Award and in 1999 an NSF Faculty Early Career Development Award. In 2008 she was elected a Fellow of the American Institute for Medical and Biological Engineering. She has been awarded both College and Sibley School teaching awards. Prof. van der Meulen is a member of the American Society for Bone and Mineral Research, the American and European Societies of Biomechanics, American Society of Mechanical Engineers and the Orthopaedic Research Society. She currently serves as a Deputy Editor of the Journal of Orthopaedic Research and is a member of the Orthopaedic Research and Education Foundation peer review committee.

Education

Ph.D. 1993 - Mechanical Engineering, Stanford University
M.S. 1989 - Mechanical Engineering, Stanford University
S.B. 1987 - Mechanical Engineering, MIT