

Mechanisms of injuries leading to musculoskeletal pathology and behavioral declines in an animal model of repetitive motion injury

Mary F Barbe

Department of Anatomy and Cell Biology, Temple University School of Medicine, 3500 N Broad Street, Philadelphia, PA

There is considerable epidemiological evidence for the role of repetition and force in the onset and progression of work-related musculoskeletal disorders; however, complete understanding of these important occupational health problems requires further elucidation of the mechanisms of injuries leading to musculoskeletal pathology and behavioral declines. We have examined exposure-response relationships in upper extremity tissues and sensorimotor behaviors using an operant behavioral rat model of repetitive reaching and pulling, in which rats performed one of four different repetition and force tasks for up to 24 weeks: 1) low repetition with low force (LRLF), 2) high repetition with low force (HRLF), 3) low repetition with high force (LRHF), and 4) high repetition with high force (HRHF). Performance of the HRLF and HRHF was associated with increased incidence of myofiber kinks, tendon fibrillation, tendon collagen disorganization, and nerve axon damage. These histological signs of injury were greatest in rats performing the HRHF task. We also observed repetitive task-induced declines in bone quality in distal forelimb bones that were linked to both loading level and inflammation. These changes included a loss of bone density and trabecular bone resorption indicative of enhanced bone fragility. Anti-inflammatory drug treatment or load reduction preserved bone mass and allowed for bone adaptation. Exposure-dependent declines in grip strength and increased pain behaviors were observed that consistently correlated with task-induced inflammatory responses in forearm tissues (HRHF>HRLF=LRHF>LRLF). Initial local tissue inflammatory responses became systemic and detectable in serum as increased inflammatory cytokines, indicating that inflammatory cytokines can serve as biomarkers of the inflammatory phase of WMSDs. Unfortunately, prolonged peripheral inflammation also drove central nervous system changes, e.g. increased nociceptor-related neurotransmitters and inflammatory cytokines in the spinal cord and brain. Although traditional anti-inflammatory treatments (ibuprofen or anti-TNF α drugs) provided after the onset of pain behaviors reduced peripheral tissue inflammation, the spinal cord changes were not ameliorated, indicative of chronic pain related neuroplasticity. Prolonged performance of the higher demand tasks were also associated with increased fibrogenic-related proteins in the tissues, including transforming growth factor beta 1 and connective tissue growth factor. These fibrogenic changes were partially attenuated by anti-inflammatory treatments when provided early during their induction, indicating a link between the inflammatory phase and the fibrotic phase. Persistent motor declines correlated with prolonged and cyclical low-grade tissue inflammatory cytokine responses as well as progressive increases of several fibrotic proteins. Many of these fibrogenic proteins were detectable in serum, suggesting that they should be monitored in patients with WMSDs. In conclusion, we propose a model of three key interrelated pathways (peripheral tissue injury-inflammation, peripheral tissue fibrosis, and CNS reorganization) that drive persistent sensorimotor behavioral declines with performance of repetitive tasks, with the greatest effects produced by high repetition high force tasks.

Tuesday, 9 July 2013

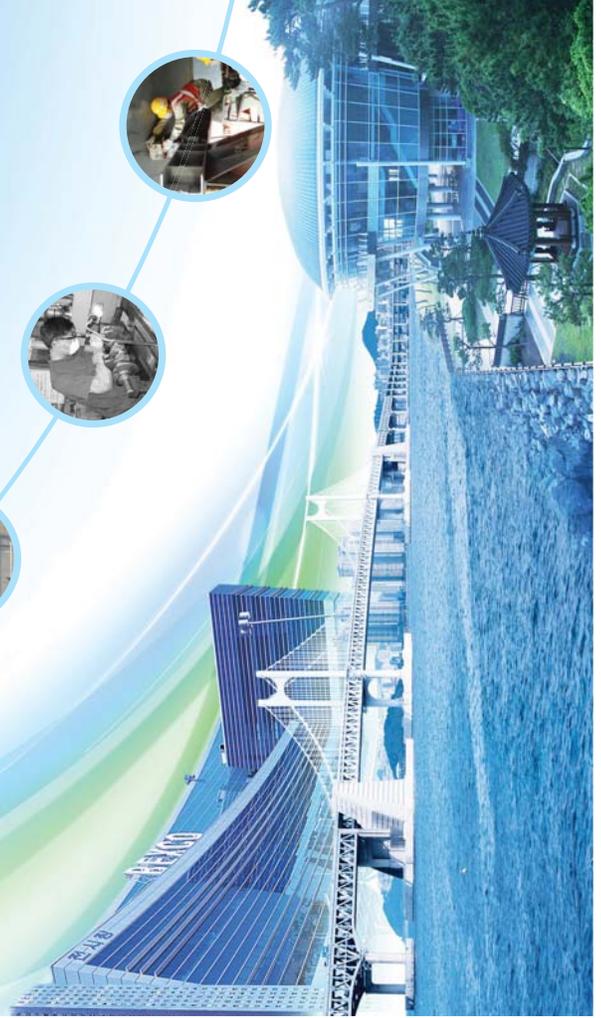
Time	Room 205	Room 201 ~ 202	Room 203	Room 204
08:30~09:15	Keynote speech (2) Chair : Sung-Kyu KANG Mary F. BARBE			
09:15~10:00	Keynote speech (3) Chair : Sung-Kyu KANG Svend-Erik MATHIASSEN			
10:00~10:30	Coffee Break (2nd floor lobby)			
10:30~12:00	<p style="text-align: center;"><Symposium> NIOSH Consortium studies of distal upper extremity disorders</p> <p>Chair : Jay M. KAPELLUSCH</p> <p>Presenters : Ann Marie DALE Stephen BAO Carisa Harris ADAMSON Kurt HEGMANN Arun GARG Susan BURT</p>	<p style="text-align: center;">Epidemiology of lower limb and others</p> <p>Chair : Bradley EVANOFF Dae-Hwan KIM</p> <p>Tine Gjedde SOMMER Allard J. van der BEEK (Laura VIESTER) Poul FROST Sorosh TABATABAEIFAR So Chun LUNG</p>	<p style="text-align: center;">Biomechanical analysis (1)</p> <p>Chair : Jung-Keun PARK Bernard J. MARTIN</p> <p>Nils FALLENTIN Mark BOOCOOCK Tetsuya HASEGAWA Sang-Uk HAN JooOh SEO Seung-Yeop LIM</p>	<p style="text-align: center;"><Symposium> Prevention of musculoskeletal disorders in the healthcare sector</p> <p>Chair : Deepak SHARAN</p> <p>Presenters : Jerrish A. JOSE Mathankumar MOHANDOSS Deepak SHARAN</p>
12:00~13:30	Lunch (Centum hotel 4th floor)			
13:30~15:00	<p style="text-align: center;"><Symposium> Natural history of upper-limb musculoskeletal disorders in working populations</p> <p>Chair : Alexis DESCATHA</p> <p>Presenters : Julie BODIN Barbara SILVERSTEIN Eléonore HERQUELOT Alexis DESCATHA</p> <p><u>Round table and synthesis :</u> Bradley EVANOFF – Yves ROQUELAURE – David REMPEL – Alexis DESCATHA</p>	<p style="text-align: center;">Psychosocial factors and work organization : effects and results</p> <p>Chair : Minori NAKATA Mats HAGBERG</p> <p>Rahman SHIRI Susan STOCK Minori NAKATA Alicia KUROWSKI Bert CORNELIUS Prawit JANWANTANAKUL</p>	<p style="text-align: center;">Biomechanical analysis (2)</p> <p>Chair : Andre KLUSSMANN Jang-Whon YOON</p> <p>Jang-Whon YOON June SPECTOR Gert FABER Myung-Kook MOON David M. ANTLE</p>	<p style="text-align: center;">Health care sector (1)</p> <p>Chair : Jodi OAKMAN Laura PUNNETT</p> <p>Lars L. ANDERSEN Malinauskiene VILJIA Nydia CHEVEREZ-RODRIGUEZ Seung-Sup KIM Ehsanollah HABIBI Ehsan RAFEEMANESH</p>
15:00~15:15	Coffee Break (2nd floor lobby)			
15:15~16:00	Poster Session II (2nd floor lobby)			
16:00~17:30	<p style="text-align: center;"><Symposium> Workplace low back disorders : Epidemiological studies</p> <p>Chair : Ming-Lun LU</p> <p>Presenters : Arun GARG William S. MARRAS Ming-Lun LU</p>	<p style="text-align: center;">Application of electromyography</p> <p>Chair : Tim BOSCH Sung-Rok JANG</p> <p>Afshin SAMANI Bernard J. MARTIN Maaïke HUYSMANS Jennifer Bruno GARZA Benjamin STEINHILBER Grace SZETO</p>	<p style="text-align: center;">Primary prevention methods</p> <p>Chair : Yves ROQUELAURE Jung-Il KIM</p> <p>Juan A. CASTILLO Wilhelmus J. A. GROOTEN Pascal SIMONET Emma IRVIN Dwayne Van EERD Ron SAUNDERS</p>	<p style="text-align: center;">Health care sector (2)</p> <p>Chair : Alex BURDORF Susan STOCK</p> <p>Laura PUNNETT Jodi OAKMAN Charlotte Diana Nørregaard RASMUSSEN Elsa LANEYRIE & Sandrine CAROLY Svein BARENE Esther MURRAY</p>
17:30~18:30	ICOH-Musculoskeletal Scientific Committee meeting (Room 204)			



Eighth International Conference on Prevention of Work-related Musculoskeletal Disorders

Busan(Korea), 7 July - 11 July 2013

ABSTRACTS



Eighth International Conference on Prevention of Work-related Musculoskeletal Disorders

ABSTRACTS

Busan(Korea)

