Vibration Injury Network

Research Network on Detection and Prevention of Injuries due to Occupational Vibration Exposures

Modelling of Spinal Loads Associated with Vibration and Shock - State of the Art, Critical Assessment, Application, and Research Needs

Appendix X5A to Final Report

May 2001

EC Biomed II concerted action BMH4-CT98-3291

Report on the 1st International Workshop "Modelling of Spinal Loads Associated with Vibration and Shock - State of the Art, Critical Assessment, Application, and Research Needs", Berlin, Germany, 19-20 October 1999.

In October 1999, a group of 35 scientists gathered in Berlin for the 1st International Workshop "Modelling of Spinal Loads Associated with Vibration and Shock". This workshop was organized by the Federal Institute for Occupational Safety and Health, Berlin, Germany, with the financial support by the European Commission under BIOMED 2 concerted action BMH4-CT98-3251 (Vibration Injury Network). Spinal loads associated with vibration and shock have been suspected to be the cause of injuries. Modeling of spinal loads can help to predict the health risk and to derive measures for prevention. The workshop provided a unique opportunity to exchange information on the most promising models, experimental data for the verification of models, and future directions of research. Researchers from various disciplines – biomechanics, physics, physiology, engineering, and medicine – exchanged their ideas with respect to the state of the art, a critical assessment of existing data, application of models and future research needs.

The partners of the Vibration Injury Network made the following contributions:

1. Blüthner R, Seidel H, Hinz B. Examination of the myoelectric activity of back muscles during random vibration - methodical approach and first results.
2. Matsumoto Y, Griffin MJ. Modelling the dynamic mechanisms associated with the principal resonance of the seated human body.
3. Seidel H, Blüthner R, Hinz B. Application of finite-element models to predict forces acting on the lumbar spine during whole-body vibration.
4. Griffin MJ. The validation of biodynamic models.
5. Hinz B, Menzel G, Blüthner R, Seidel H. Transfer functions as a basis for the verification of models - variability and restraints.
6. Holmlund P, Lundström R. Mechanical impedance of the sitting human body in a single axis compared to multi-axis whole-body vibration exposure.
7. Pope MH, Goudas CL, Goudas P. Materials properties and boundary conditions for models of the lumbar spine.
8. Goudas P, Labeas GG, Macropoulos V, Goudas CL. Impacts upon the L5/S1 disk under conditions of extreme loadings caused by whole-body vibration at frequencies of extremes smaller than the natural frequency of the disk using a detailed FE model.
9. Goudas P, Labeas GG, Macropoulos V, Goudas CL. Impacts upon the system of the vertebrae L5 and S1 and their disk under conditions of extreme loadings caused by whole-body vibration at frequencies of extremes smaller than the natural frequency of the disk using a detailed FE model.

As a result of the workshop, the following papers were published in the peer reviewed international journal *Clinical Biomechanics*:

Contributions of Vibration Injury Network participants

1. Seidel H, Griffin MJ. Editorial: 1st International Workshop Modelling of Spinal Loads Associated with Vibration and Shock.
2. Seidel H, Griffin MJ. Modelling the response of the spinal system to whole-body vibration and repeated shock.
3. Blüthner R, Seidel H, Hinz B. Examination of the myoelectric activity of back muscles during random vibration - methodical approach and first results.
4. Matsumoto Y, Griffin MJ. Modelling the dynamic mechanisms associated with the principal resonance of the seated human body.
5. Seidel H, Blüthner R, Hinz B. Application of finite-element models to predict forces acting on the lumbar spine during whole-body vibration.
6. Griffin MJ. The validation of biodynamic models.
7. Hinz B, Menzel G, Blüthner R, Seidel H. Transfer functions as a basis for the verification of models - variability and restraints.
8. Holmlund P, Lundström R. Mechanical impedance of the sitting human body in a single axis compared to multi-axis whole-body vibration exposure.

Contributions of other participants

1. Dolan P, Adams MA. Recent advances in lumbar spinal mechanics and their significance for modelling.
2. Dolan P, Kingma I, Looze MPde, Dieen JH van, Toussaint HM, Baten CTM, Adams MA. An EMG technique for measuring spinal loading during asymmetric lifting.
3. Pankoke S, Hofmann J, Wölfel HP. Determination of spinal loads by numerical simulation.
4. Cullmann A, Wölfel HP. Design of an active vibration dummy of sitting man.
5. Zander Th, Rohlmann A, Bergmann G. Estimation of muscle forces in the lumbar spine during upper-body inclination.
6. Wilke H-J, Neef P, Hinz B, Seidel H, Claes L. Intradiscal pressure together with anthropometric data – a data set for the validation of models
7. El-Khatib A, Guillon F. Lumbar intradiscal pressure and whole-body vibration – first results.
8. Dieen JH van, Kingma I, Meijer R, Hänsel L, Huiskes R. Stress distribution changes in bovine vertebrae just below the endplate after sustained loading.