

CHRONIC WORK-RELATED MYALGIA

Neuromuscular Mechanisms behind
Work-Related Chronic Muscle Pain Syndromes

Håkan Johansson, Uwe Windhorst,
Mats Djupsjöbacka, Magda Passatore

Editors



Centre for Musculoskeletal Research
University of Gävle

*Published by
Gävle University Press*

Professor Dr Håkan Johansson
Centre for Musculoskeletal Research
University of Gävle
P.O Box 7629
S-907 12 Umeå, Sweden

Professor Dr Uwe Windhorst
Centre for Musculoskeletal Research
University of Gävle
P.O Box 7629
S-907 12 Umeå, Sweden
and
Zentrum Physiologie und Pathophysiologie
Universität Göttingen
Humboldtallee 23
D-37073 Göttingen, Germany

Dr Mats Djupsjöbacka
University of Gävle
Centre for Musculoskeletal Research
Box 7629
S-907 12 Umeå, Sweden

Professor Dr Magda Passatore
Department of Neuroscience – Physiology
University of Torino Medical School
C.so Raffaello 30
10125 Torino , Italy

ISBN: 91-974948-0-1

Copyright © 2003 by Håkan Johansson, Uwe Windhorst, Mats Djupsjöbacka, Magda Passatore

All rights are reserved, whether the whole or parts of the material are concerned. Specifically, The rights extend over the rights of translation, reproduction, use of illustrations, recitations, broadcasting, reproduction on microfilm or any other storage media and in data banks. Duplication of this books or parts thereof is forbidden without written permission by the copyright holders.

Cover illustration: Andreas Vesalius 1514-1564

PREFACE

This book will be, as we hope, a timely contribution to the augmenting discussion about Chronic Work-Related Myalgia (CWRM). It sprang from a symposium held at the Office of the Swedish Trade Unions in Brussels on 7-9 February 2000. This symposium, initiated and organized by Håkan Johansson (Umeå), was designed in preparation for the Work Life 2000 Conference, held in Malmö on 22-25 January 2001, under the auspices of the Swedish Presidency of the European Union and supported by the Swedish National Institute for Working Life, the Swedish National Board of Occupational Safety and Health, the Swedish National Labour Market Board, and the Swedish Joint Industrial Safety Council.

The primary goal of the symposium was to bring together researchers from different fields, of different background, experience and perspective, in order to integrate findings and promote communication. This is also the intention of this book. It is not, however, a simple compendium of conference contributions. While all speakers at the symposium have delivered chapters, additional contributions have come from authors who have subsequently been invited to write contributions to round off the book. The original idea was to write a book highlighting the pathophysiological mechanisms behind CWRMs. The intention was, and still is, to send a message to applied researchers, practitioners and the general public that current hypotheses about such mechanisms are more often complementary than contradictory. If this realization could promote interdisciplinary communication, it would serve a tremendous service to applied research.

Bringing together this book would not have been possible without the assistance of many people and institutions.

In the first place, we are most grateful to all the authors contributing chapters to the book, for their expertise, efforts, persistence, patience, and willingness to update their chapters.

We would like to thank several other people who have been instrumental in publishing the book: Dr. Leif Svensson, President of the University of Gävle, and Dr. Håkan Attius, Executive Officer, R&D Department, University of Gävle.

We owe cordial thanks to the staff of the Centre for Musculoskeletal Research of the University of Gävle for their very dedicated work in the organization of the material and layout of the book, in particular Christina Ingmanson, Stina Langendoen and Margaretha Marklund.

Last but not least, we appreciate, and are grateful for, the financial support provided by Gävle University, by Astra Zeneca International, and by the Swedish National Institute for Working Life.

Håkan Johansson
Umeå, December 2003

Uwe Windhorst

Mats Djupsjöbacka

Magda Passatore

CONTENTS

Introduction	1
<i>Mats Djupsjöbacka, Håkan Johansson, Magda Passatore, Uwe Windhorst</i>	
Neuromuscular Mechanisms behind Chronic Work-Related Myalgias: An Overview	5
<i>Sidney Blair, Mats Djupsjöbacka, Håkan Johansson, Milos Ljubisavljevic, Magda Passatore and Uwe Windhorst, Laura Punnett</i>	
Work-Related Upper Extremity Disorders: Epidemiologic Findings and Unresolved Questions	47
<i>Laura Punnett and Judith E. Gold</i>	
Stress: An Introductory Overview	57
<i>Nebojsa Kalezic, Silvestro Roatta, Eugene Lyskov and Håkan Johansson</i>	
Stress, Environmental Intolerance and Musculoskeletal Symptoms	73
<i>Eugene Lyskov</i>	
The Contribution of Task-Related Biomechanical Constraints to the Development of Work-Related Myalgia	83
<i>Jaap H. van Dieën, Bart Visser and Veerle Hermans</i>	

Morphological Features Related to Muscle Pain and Muscle Overload	95
<i>Lars-Eric Thornell, Fawzi Kadi, Rolf Lindman and Fatima Pedrosa-Domellöf</i>	
Neck-Shoulder Pain in Relation to Blood Microcirculation and EMG, Psychophysiological Stress	111
<i>Sven-Erik Larsson</i>	
Metabolic and Mechanical Changes during Low-Intensity Work and their Relation to Work-Related Pain	117
<i>Nina K. Vøllestad and Cecilie Røe</i>	
The Cinderella Hypothesis	127
<i>Göran M Hägg</i>	
Motor Unit Recruitment in Relation to Genesis of Muscle Pain (Cinderella Hypothesis)	133
<i>Nils Fallentin</i>	
Interaction between Muscle Pain and Motor Control	141
<i>Thomas Graven-Nielsen, Peter Svensson and Lars Arendt-Nielsen</i>	
Neurophysiological Mechanisms behind Work-Related Myalgia: Effects on Proprioception and Balance	155
<i>Mikael Bergenheim</i>	
Effects of Experimental Muscle Pain on H- and Stretch Reflexes	163
<i>Dagfinn Matre and Peter Svensson</i>	
Effects of Physical Work Exposure on Proprioception	175
<i>Mats Djupsjöbacka</i>	

Dizziness and the Contribution of the Human Neck to Orientation. A Hypothesis for the Etiology of ‘Cervical Dizziness’ and the Interaction between Perceived Orientation and Muscle Tension in the Cervical Segment	185
<i>Måns Magnusson and Mikael Karlberg</i>	
Short-term Effects of Group III-IV Muscle Afferent Nerve Fibers on Bias and Gain of Spinal Neurons	191
<i>Uwe Windhorst</i>	
Neuroplasticity and Modulation of Chronic Pain	207
<i>Uwe Windhorst</i>	
Pain-Related Changes in Cortical Activity and Plasticity	225
<i>Milos Ljubisavljevic</i>	
Possible Roles of Sympathetic Nerve Activity in Work-Related Muscle Pain	233
<i>Tadaaki Mano</i>	
Sympathetic Nervous System : Interaction with Muscle Function and Involvement in Motor Control	243
<i>Magda Passatore and Silvestro Roatta</i>	
Sympathetic Nervous System: Sensory Modulation and Involvement in Chronic Pain	265
<i>Silvestro Roatta, Nebojsa Kalezic and Magda Passatore</i>	
Long-Term Trophic Effects of Sympathetic Nerves on Skeletal Muscle	277
<i>Zofia Zukowska and Edward W. Lee</i>	
	283

Reflex Sympathetic Dystrophy (Complex Regional Pain Syndrome)	283
<i>Sidney Blair</i>	
Epilogue: An Integrated Model for Chronic Work-Related Myalgia "Brussels Model"	291
<i>Håkan Johansson, Lars Arendt-Nilsson, Mikael Bergenheim, Sidney Blair, Jaap van Dieen, Mats Djupsjöbacka, Nils Fallentin, Judith E. Gold, Göran Hägg, Nebojsa Kalezic, Sven-Erik Larsson, Milos Ljubisavljevic, Eugene Lyskov, Tadaaki Mano, Måns Magnusson, Magda Passatore, Fatima Pedrosa-Domellöf, Laura Punnett, Silvestro Roatta, L-E Thornell, Uwe Windhorst, Zofia Zukowska</i>	
Subject Index	301

LIST OF CONTRIBUTORS

Lars Arendt-Nielsen
Center for Sensory-Motor Interaction
Laboratory for Experimental Pain Research
Aalborg University
Aalborg
Denmark
E-mail: LAN@smi.auc.dk

Mikael Bergenheim
Central Hospital
Karlstad, Sweden
and
Centre for Musculoskeletal Research
University of Gävle
P.O Box 7629
S-907 12 Umeå
Sweden
E-mail: mbe@hig.se

Sidney Blair
Department of Orthopaedic Surgery and
Rehabilitation
Loyola University Medical Center
Maywood
Illinois
Chicago
USA
E-mail: FGLAIR1763@aol.com

Mats Djupsjöbacka
University of Gävle
Centre for Musculoskeletal Research
Box 7629
S-907 12 Umea
Sweden
E-mail: mda@hig.se

Nils Fallentin
National Institute of Occupational Health
Copenhagen
Denmark
E-mail: nf@ami.dk

Judith E. Gold
Department of Work Environment
University of Massachusetts Lowell
USA
E-mail: Judith_Gold@uml.edu

Thomas Graven-Nielsen
Center for Sensory-Motor Interaction
Laboratory for Experimental Pain Research
Aalborg University
Aalborg
Denmark
E-mail: tgn@miba.auc.dk

Göran M Hägg
Ergonomics group
Department for Work and Health
National Institute for Working Life
SE-113 91 Stockholm
Sweden
E-mail: goran.hagg@arbetslivsinstitutet.se

Veerle Hermans
PREVENT vzw
Institute for Occupational Safety and Health
Brussels
Belgium
and
Faculty of Psychology and Education
Vrije Universiteit Brussels
Brussels
Belgium
E-mail: v.hermans@prevent.be

Håkan Johansson
Centre for Musculoskeletal Research
University of Gävle
P.O Box 7629
S-907 12 Umeå
Sweden
E-mail: Hakan.Johansson@hig.se

Fawzi Kadi
Department of Physical Education and Health
Örebro University
701 82 Örebro
Sweden

Nebojsa Kalezic
Centre for Musculoskeletal Research
University of Gävle
P.O Box 7629
S-907 12 Umeå
Sweden
E-mail: Nebojsa.Kalezic@hig.se

Mikael Karlberg
Department of Otorhinolaryngology
University of Lund
S-221 85 Lund
Sweden

Sven-Erik Larsson
Department of Orthopaedic Surgery
University Hospital
S-581 85 Linköping
Sweden
Private: Pilholmsväg 15,
S-589 37 Linköping,
Sweden

Edward W. Lee
Department of Physiology & Biophysics
Georgetown University Medical Center
Washington
DC 20007
USA
E-mail: leeew@georgetown.edu

Rolf Lindman
Department of Integrative Medical Biology
Section of Anatomy
Umeå, University
and
Centre for Musculoskeletal Research
University of Gävle
P.O Box 7629
S-907 12 Umeå
Sweden
E-mail: rolf.lindman@anatomy.umu.se

Milos Ljubisavljevic
Department of Neurophysiology
Institute for Medical Research
Dr Subotica 4
P.O. BOX 102
11129 Belgrade
Serbia
E-mail: milos@imi.bg.ac.yu

Eugene Lyskov
Centre for Musculoskeletal Research
University of Gävle
P.O Box 7629
S-907 12 Umeå
Sweden
E-mail: Eugene.Lyskov@hig.se

Måns Magnusson
Department of Otorhinolaryngology
University of Lund
S-221 85 Lund
Sweden
E-mail: mans.magnusson@onh.lu.se

Tadaaki Mano
Tokai Central Hospital
4-6-2, Sohara-Higashijima-cho,
Kakamigahara, Gifu 504-8601
Japan
E-mail: tadaaki.mano@nifty.ne.jp

Dagfinn Matre
Department of Physiology
National Institute of Occupational Health
Oslo
Norway
E-mail: Dagfinn.Matre@stami.no

Magda Passatore
Department of Neuroscience – Physiology
University of Torino Medical School
C.so Raffaello 30
10125 Torino
Italy
E-mail: magda.passatore@unito.it

Fatima Pedrosa-Domellöf
Department of Integrative Medical Biology
Section of Anatomy
Umeå, University
and
Centre for Musculoskeletal Research
University of Gävle
P.O Box 7629
S-907 12 Umeå
Sweden
E-mail: fatima.pedrosa-domellof@anatomy.umu.se

Laura Punnett
Department of Work Environment
University of Massachusetts Lowell
USA
E-mail: Laura_Punnett@uml.edu

Silvestro Roatta
Department of Neuroscience – Physiology
University of Torino Medical School
C.so Raffaello 30
10125 Torino
Italy
E-mail: silvestro.roatta@unito.it

Cecilie Røe
Dept. of Physiology
National Institute of Occupational Health
Oslo
Norway
E-mail: Cecillie.Roe@stami.no

Peter Svensson
Department of Clinical Oral Physiology
Aarhus University
Aarhus
Denmark
E-mail: psvensson@odont.au.dk

Lars-Eric Thornell
Department of Integrative Medical Biology
Section of Anatomy
Umeå, University
and
Centre for Musculoskeletal Research
University of Gävle
P.O Box 7629
S-907 12 Umeå
Sweden
E-mail: lars-eric.thornell@anatomy.umu.se

Jaap H. van Dieën
Institute for Fundamental and Clinical Human
Movement Sciences
Faculty of Human Movement Sciences
Vrije Universiteit Amsterdam
Amsterdam
The Netherlands
E-mail: j_h_van_dieen@fbw.vu.nl

Bart Visser
Institute for Fundamental and Clinical Human
Movement Sciences
Faculty of Human Movement Sciences
Vrije Universiteit Amsterdam
Amsterdam
The Netherlands

Nina K. Vøllestad
Section for Health Science
University of Oslo
P.O. Box 1153 Blindern
NO-0316 Oslo
Norway
E-mail: nina.vollestad@helsefag.uio.no

Uwe Windhorst
Centre for Musculoskeletal Research
University of Gävle
P.O Box 7629
S-907 12 Umeå
Sweden
E-mail: uwt@hig.se
and
Zentrum Physiologie und Pathophysiologie
Universität Göttingen
Humboldtallee 23
D-37073 Göttingen
Germany
E-mail: siggi.uwe@t-online.de

Zofia Zukowska
Department of Physiology and Biophysics
Georgetown University Medical Center
Washington
DC 20007
USA
E-mail: zzukow01@georgetown.edu