International Society of Biomechanics Newsletter

ISSUE Number 48, NOVEMBER / DECEMBER, 1992

PRESIDENT
Dr. Aurelio Cappozzo
Istituto Di Fisiologia Umana
Università Degli Studi 'La Sapienza'
00185 Roma
ITALY
Tel: 39-6-490673
Fax: 39-6-445-2303

PRESIDENT-ELECT
Dr. Ronald Zernicke
University of Calgary
Department of Surgery
3330 Hospital Drive N.W.
Calgary, Alberta T2N 4N1
CANADA
Tel: (403) 220-8666
Fax: (403) 283-4740

PAST PRESIDENT
Dr. Robert W.K. Norman
Dept. of Kinesiology
University of Waterloo
Waterloo, Ontario N2L 3G1
CANADA
Tel: (519) 885-1211 ext. 2205
Fax: (519) 746-6776

SECRETARY-GENERAL
Dr. Peter R. Cavanagh
The Centre for Locomotion Studies
The Pennsylvania State University
University Park, Pennsylvania
USA 16802
Tel: (814) 865-1972
Fax: (814) 8634755
E-Mail: prc@ecl.psu.edu

TREASURER and
NEWSLETTER EDITOR
Dr. Graeme A. Wood
Department of Human Movement
The University of Western Australia
Nedlands, WA 6009
AUSTRALIA
Tel: +61-9-380-2361
Fax: +61-9-380-1039
E-Mail: gwood@fennel.cc.uwa.oz.au

TABLE OF CONTENTS

AFFILIATE SOCIETIES OF ISB:
American Society of Biomechanics; British Association of Sports Science; Canadian Society of Biomechanics; China Sports Biomechanics Association; Czechoslovak Committee on Biomechanics; French Société de Biomécanique; Korean Society of Biomechanics; Polish Society of Biomechanics; Sports Commission of the Soviet Union.

ISB News

MEMBERSHIP RENEWALS

Enclosed with this Newsletter is your ISB Membership Renewal Notice. Payment can now be made by credit card as well as by bank cheque or money order. Please note that all amounts are stated in Australian Dollars (AUD), and any cheque or money order must be in this currency. If you have been a previous subscriber to either the *Journal of Biomechanics* or the *International Journal of Sport Biomechanics* then your have been automatically billed for the additional subscription fee(s). If, however, you wish to change your (optional) subscription status then please amend the statement accordingly and indicate the revised total.

On the reverse side of your renewal notice is a list of information which we would like to maintain on each member of the society. Completion of this information is optional and its use will be confined to society business only.

Early receipt of your renewal monies or debit approval would be appreciated. Subsequently, you will receive an official membership ID card.

CALL FOR NOMINATIONS FOR ISB COUNCIL

It is now time to put together a slate of nominees for the 1993-1994 Council. Several current Council members are eligible for re-election and some will appear on the ballot. The Council invites nominations from the membership-at-large.

Please send your nomination in a memo along with a memo of agreement from your nominee to stand for election, and a short biography of your nominee. The biography should include the nominee's current position, research activities, history of participation in the field of biomechanics in general and ISB events in particular. Please include their current address, phone and fax number if possible.

Nominations should be sent to:

Dr. Bob Norman
Dean, Faculty of Applied Health Sciences
University of Waterloo
Waterloo, ON
N2L 3G1
CANADA

Phone # 519-885-1211 ext. 2205
Fax # 519-746-6776
email # Norman@WATDCS.UWaterloo.ca

To be received by March 1, 1993.

MUYBRIDGE MEDAL NOMINATIONS

The Muybridge Medal is the Society's highest award and is normally made biennially to an individual for major contibutions to biomechanics that have an appreciable impact on basic research issues and/or methodological development and/or applications. A "pool" of two - three potential recipients is maintained by the Awards Committee to facilitate selection for each Congress. Nominations for possible inclusion in this pool are now being sought from ISB members. Nominations should be accompanied by a current curriculum vitae of the nominee and be sent to:

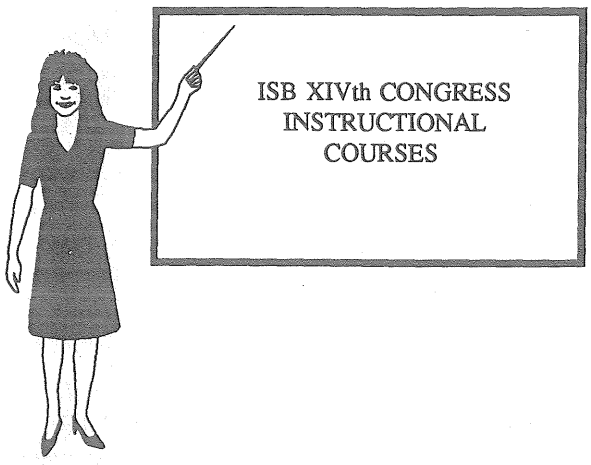
Dr Paavo V. Komi
Chair, Muybridge Award Committee
Department of Biology of Physical Activity
University of Jyväskylä
P.O. Box 35
SF-40351 Jyväskylä
FINLAND
Tel: +358 41 602 073
Fax: +358 41 602 071

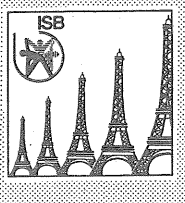
XIVth CONGRESS OF BIOMECHANICS:- INSTRUCTIONAL TUTORIALS

Four Instructional Tutorials will be offered by leaders in Biomechanics as a prelude to the XIVth International Congress on Biomechanics, each three hours duration. These have been arranged for Sunday 4 July, 1993 and will take the following format:

9H00 to 12H00	(1) Three-dimensional analysis of human movement - *Paul Allard and Joannes Dimnet*
	(2) Biology and biomechanics of tendons and ligaments - *Savio Woo*
13H00 to 16H00	(3) Clinical gait analysis - *Kit Vaughan and Diane Damiano*
	(4) Biomechanical assessment of worksit tasks - *Bob Norman, Stuart McGill and Richard Wells*

An extensive set of notes will be handed out to all those who register and attend. A detailed listing of the material to be covered will be published shortly, together with registration details and costs (modest).





BIOMECHANICS

XIVth I.S.B. Congress

Paris - France
4 - 8 July 1993

Deadline for receipt of abstracts
December 31, 1992

CONGRESS TOPICS

Biomechanics of Human Movement
Sport Biomechanics
Occupational Biomechanics
Assessment of Muscle Function and Rehabilitation
Clinical Orthopaedics Biomechanics
Biomechanics and Neurology

Musculo-Skeletal Biomechanics
Neuromuscular Control of Posture and Movement
Muscle Mechanics and Energetics
Biomechanics of Joints and Spine
Electromyographic Analysis

Environmental Biomechanics in Humans and Animals
Impact and Vibration Biomechanics
Micro and Hypergravity Biomechanics
Terrestrian, Water, and Air Locomotion

Biomechanical Methodology
Methods and Instrumentation
Measurement and Data Processing
Computer Modeling
Simulation and Optimization in Biomechanics

Biomechanics of Tissues and Biomaterials
Soft and Hard Tissue Biomechanics
Biomaterials
Prostheses, Orthoses and External Fixations

Cardio-Respiratory Biomechanics
Cardiac and Vascular Biomechanics
Respiratory Biomechanics
Biorheology

SCIENTIFIC PROGRAM

Highlights

Wartenweiler Memorial Lecture - *Carlo A. De Luca*
• Limits on the use of electromyography in Biomechanics

Muybridge Lecture - *Malcolm H. Pope*
• Biomechanics of low back pain

Keynote Lectures

• Interaction between central programs and efferent inputs in control of posture and locomotion - *Volker Dietz*
• Remodeling of tendons and ligaments - *Kosaburo Hayashi*
• Dynamics of blood circulatory systems under exercise or extreme environment - *Christian Oddou*
• Mechanics of bird flight - *Colin J. Pennycuick*
• New principles in Dynamics of multi-arm robot manipulators: Application to the control of multi-joints human movements - *Eugeniy S. Pyatnitskiy*
• Infant motor development: facts and theories - *Esther Thelen*

Round Tables

• Optimization of Sports Performance - *Coordinator: Wolfgang Baumann*
• Sensory motor adaptation to microgravity - *Coordinator: Alain Berthoz*
• Biomechanical Assessment of Motor Impairments - *Coordinator: Richard A. Brand*
• Paraplegics locomotion - *Coordinator: John P. Paul*

Tutorials - July 4, 1993

• Three-dimensional analysis of human movement - *Coordinator: Paul Allard*
• Biology and biomechanics of ligaments and tendons - *Coordinator: Savio J. Woo*
• Clinical gait analysis - *Coordinator: Christopher L. Vaughan*
• Biomechanical assessment of worksite tasks - *Coordinator: Robert W. Norman*

Satellite Events to the XIVth International Congress on Biomechanics

• Second International Symposium on 3-D Analysis of Human Movement - June 30 - July 3, 1993 - Poitiers - France
• Fourth International Symposium on Computer Simulation in Biomechanics- June 30 - July 2, 1993 - Montlignon - France

EXECUTIVE COMMITTEE

Simon BOUISSET
Stephane METRAL
Ilugues MONOD

CONGRESS OFFICE

CONVERGENCES - ISB '93
120, avenue Gambetta 75020 PARIS
Fax: (33-1)40.31.01.65

IN MEMORIUM

- HERMAN J. WOLTRING -

It was with deep sorrow and heartfelt sympathy for Margriet Woltring and her children that we learned of the death of Herman Woltring on November 3, 1992. The thoughts and wishes of all our members are with the Woltring family at this time of great loss. We wish them every strength to bear this enormous and untimely tragedy.

While those of us who knew Herman also feel a deep sense of personal loss, we know too that Herman will be an irreplaceable loss to the scientific community where he will be remembered as a dynamic figure of towering intellect. He made contributions to the field of numerical analysis and three dimensional reconstruction in Biomechanics that will stand as beacons in the literature for many years to come. There is no single individual in the world who has the breadth and depth of knowledge in this area that Herman possessed.

Herman attended all the meetings of The International Society of Biomechanics over the last 15 years and was a vivid and engaging participant in these meetings. He was also to be a key member of the organizing committee of the satellite meeting on Three Dimensional Analysis of Human Movement in Poitiers in 1993 and was extremely active in the promotion of this endeavor.

In the last five years, he spent much of his energy on the new field of electronic communication to which he became passionately devoted. He served as moderator of the BIOMCH-L bulletin board which provided an immediate link between biomechanical scientists all over the world. Through this medium, it true to say that Herman influenced almost every single worker in our field and was constantly exploring new avenues for bringing scientists together. His erudite comments and voluminous contributions to ongoing intellectual debates in these electronic forums were second to none. Many of us have been logged on to our computers in what was the middle of the European night, only to be surprised by a personal message from Herman who found that we were connected during his seemingly endless "patrols" of the electronic ether.

Like many creative individuals, Herman was no stranger to controversy. Yet it was his particular genius to turn adversity into advantage. After becoming engaged in debate over intellectual property rights, he studied the field intensely and actually contributed to the debate on this topic in academic legal circles. When his beloved "helical axes" came under fire he located a series of obscure and little known historical articles in support of this method of description.

He was a consummate linguist, and his facility, speed, and volubility in many languages was legendary. Once given the podium, he found it extremely difficult to conclude within his allotted time span. I recall organizing a meeting at Penn State in which a first year masters student was given the task of reminding Herman that his 10 minute presentation should come at an end. Only by appearing behind him at 15 minutes with an imaginary hook was she able to persuade him to conclude. He endured this one of his many ordeals with the clock by a good natured remark about the speed of light and an ongoing discussion of some important part of the presentation as he was walking to his seat. Herman has been referred to as the "Mathematical Conscience of Biomechanics" and there are few who would argue the truth of this appellation. He was ready to examine the merits of any mathematical proposition at any time of the day or night, and he was rarely -- if ever -- wrong in his conclusion. Figures such as Herman are encountered all too infrequently in scientific life. He challenged, enlightened, and stimulated us all to greater accomplishments. We feel his loss deeply and will long carry with us the memory of his exceptional life and times.

Peter R. Cavanagh, Ph.D.
Secretary General
International Society of Biomechanics.

To Margriet and the family -

Herman was a good friend. His academic achievements and contributions to biomechanics internationally have been well chronicled by many of his other colleagues. These plaudits are well deserved but I thought I would tell one of many amusing stories that Herman shared with me. I want to remember him that way. This happened while you and Herman were at the University of Waterloo in 1977 and 1978. In fact he taught one of my biomechanics courses for me here in Canada while I was on a sabbatical leave in Finland.

It seems that Herman was issued a traffic ticket on one of our highways. He argued with the police that he did not see a speed limit sign. The police told him to tell it to the judge in court. He did. But before appearing in court to defend himself, Herman studied, and seemed to have memorized the entire Highway Traffic Act and all the related laws in the Province of Ontario. In small print, he discovered that speed limit signs were to be posted no farther apart than a specified distance (a few kilometres). Herman went back to the site of his ticket and measured the distance. The signs were too far apart but by only a few hundred meters.

He went to court to defend himself armed with all of these books, more current and detailed knowledge of these traffic laws than the judge, photographs of the road and offending signs and a rapid fire verbal defence.

The judge was over-powered. He had never heard a case presented so thoroughly, so fast and so relentlessly by lawyers whose first language was English, to say nothing of a lay person from another country whose primary language is not English.

After ten minutes of non-stop analysis at high speed, the judge rose majestically as Herman continued and shouted Stop, Stop, Stop! We will share the fine, $26.

Jean Ann and I will miss him and share your grief.

Bob Norman

The following personal comments were posted onto the BIOMCH-L electronic network by users of that facility following the anouncement of Herman's tragic death. They bear testimony to Herman's very significant and esteemed contribution to the international community of movement scientists and biomechanists as the originator and co-moderator of that service and are reprinted here by permission.

To Friends of Herman Woltring:

The saddening message has reached me that on Tuesday November 3 your and my friend and colleague Herman Woltring was killed in a car accident.

It is hard to instantly find words fitting to such an early and sudden loss. Some of you will, like me, have known Herman professionally for over twenty years, others will have only recently enjoyed the pleasure of his acquaintance.

Those words of remembrance and condolence which you may feel brimming up, will be collected at my email address and through Herman's brother passed on to Margriet and the children he left behind.

Hans Furnee.

To Friends of Herman Woltring:

Each morning here in Salt Lake City, Utah, I look forward to checking the BIOMCH-L list to read the latest postings and words of Herman Woltring. It was with great sadness that I read this morning of his passing.

I have only known Herman through this medium; have never met him or talked to him. But in the short few months that I have known and conversed with him on matters of medical interest, I have found Herman to be a kind, caring and brilliant person that seems to have been able to get an immense amount of work done in a short time.

On one occasion, I told Herman of my appreciation for his work. Now, with no way to contact him further, I am very happy that I took that little bit of time to tell him so. I know I will miss him.

Herman has many friends around the world that mourn his passing.

With respect,

Jim Harvey.
3114 Robinwood Dr.
Salt Lake City, Utah 84118, USA

Dear Colleagues,

It is hard to express what Herman's death means to me. He was a mentor to me, and taught me basically everything I know about 3-D analysis of movement. I am indebted to him for this, and feel priviliged to have known him. But there is still so much to learn, and we (i.e. the biomechanics community) are now on our own. That loss will be felt by everyone who knew him.

Herman's enthusiasm, and readiness to help should be an example to all of us. He was unique and will not be forgotten. It is frustrating to be so far away at a time like this. My thoughts are with his family.

Biomch-L will continue to exist, and will (for the time being) be administrated by myself, Krystyna Gielo-Perczak, and Christoph Reinschmidt. But we cannot hope to come close to what Herman did.

Ton van den Bogert, University of Calgary
Biomch-L co-moderator

Dear Biomch-L collegues:

I was shocked to note the demise of Herman Woltring and I would like to express my sincere thanks to his efforts for bringing together this great network and for the great contributions that he has done to the biomechanics world. His explanations on both Biomech and the network questions that came up on this network were excellent and gave an opportunity for students like me to understand the concepts and motivated us to do further research. I am sure that all of us in the Biomech world would remember Herman Woltring for his wonderful work.

Ramji Venkatachari.

On behalf of the Executive Council of the International Society of Biomechanics and of all of its members, I express my deepest condolences for the premature death of Herman Woltring, most esteemed colleague and friend. The Biomechanics Community respectfully bows before his tomb and receives his outstanding cultural legacy.

Aurelio Cappozzo.
President
International Society of Biomechanics

Dear Fellow Biomechanists:

This news of Herman Woltring's death hits me very hard. Herman had become my email "pen pal" since the inception of Biomch-L. Although I had met Herman at professional meetings prior to the UCLA ISB meeting, it is there that he and I struck up a friendship and began corresponding via email on a regular basis. I could ask him questions about anything related to biomechanics at virtually any hour of the day or night and get prompt replies back (many times within minutes). He was absolutely instrumental in bringing biomechanics to the age of electronic communication and for his efforts in facilitating my understanding of the field I will be forever grateful. To my friend and colleague; Herman, I will miss you.

Richard N. Hinrichs, Ph.D.
Dept. of Exercise Science
Arizona State University
Tempe, AZ 85287-0404 USA

The news of Herman's death came as a shock to all of us. No words can express the depth of our sorrow. He was an outstanding academic and personal example to us all. Without the brilliance of his contributions to biomechanics, studies in this field could not have progressed to their present level.

His generosity and enthusiasm for sharing knowledge through the email network have enabled his colleagues world - wide to achieve a level of communication and mutual understanding that has benefited individuals and the field of biomechanics at large.

The co-moderators of Biomch-L Forum are inspired to continue Herman's work, though intensely aware of the impossibility of matching his standards.

Herman was a great scientist and teacher, and an extraordinary man. He will always be in our thoughts.

Krystyna Gielo-Perczak
Victoria University of Technology
Melbourne, Australia
Biomch-L co-moderator

Dear Colleagues,

The news of Herman's sudden death has hit me very hard. I met Herman for the first time during an annual Congress of the French Society of Biomechanics, a lot of years ago... and now, as a member of the Scientific Committee of the 2nd symposium of 3D Movement analysis, (satellite event of our next ISB congress), he had to chair... During the last months we exchanged many email messages, and it had been my pleasure to reach the Biomch-L community last September under his auspices. I really feel the loss of a major contributor in Biomechanic fields, and the loss of a spontaneous friend and Colleague.

With regards
Bernard Landjerit, PhD
ENSAM Paris France.

Herman Woltring was to many of us a personal friend and esteemed colleague. His contributions to our research work in the field of human joint biomechanics is gratefully acknowledged.

It is hard to realize that this remarkable and friendly person is no longer with us. We will miss the sparkling conversations and Emails with him.

We sincerely sympathize Margriet and the children with this tragic loss.

Workers and Co-workers of:
Biomechanics Section
Institute of Orthopaedics
University of Nijmegen
Nijmegen
The Netherlands.

In remembrance of Herman J. Woltring (1943-1992)

The extent of his reading enabled Herman to find citations appropriate for any scientific dispute that he was involved in with his colleagues. Many of us were familiar with this. Therefore, to remember him, some of the citations at the beginning of the chapters of his PhD-thesis "Measurement and control of human movement", Nijmegen, 1977:

> "An object is at rest when it occupies a space equal to itself. An arrow in flight occupies, at any given moment, a space equal to itself. Therefore, an arrow in flight is at rest." (Zeno of Elea's third syllogism against the existence of motion).
>
> "There are six sorts of movement: generation, destruction, increase, decrease, diminution, alteration and change of place." (Aristotle, Categoriae 15a 14)
>
> "The first creature of God, in the works of the days, was the light of the senses, the last was the light of reason." (Francis Bacon, Essays: of Truth)
>
> "It is the depth at which we live and not all the surface extension that imports." (R.W. Emerson, Society and Solicitude)
>
> "If I were running in the stadium, ought I to slacken my pace when approaching the goal? Ought I not rather to put on speed?" (Diogenes, when told that he should take a rest since he was an old man.)
>
> "Every little movement has a meaning all of its own." (Harbach and Hoschna - song hit in "Madame Sherry", 1990)
>
> "We will not anticipate the past; so mind, young people - our retrospection will now be all to the future." (Sheridan, The Rivals, Act. iv, sc. 2)

Leendert Blankevoort
Nijmegen, 5 November, 1992
Leendert Blankevoort

Dear fellow members of the biomechanics community,

I just returned from out of town expecting to see a long list of email from BIOMCH-L and maybe a couple messages directly from Herman. Instead, I find a message which reminds me of the frailty and preciousness of life.

Herman encouraged me over the last 5 years to continue developing locomotion software for public distribution. If not for him, I doubt that this would be on the BIOMCH-L fileserver today. He was such a source of information for the biomechanics community. His efforts served as a catalyst for numerous projects, many of which are still in their formative stages. Our greatest tribute to Herman will be continue these efforts.

Now Jette and I will not be able to search for Herman at every biomechanics conference we attend, no matter how small or local, fully expecting to find him deeply engaged in conversation. His intellect was without question, his commitment without end, and his sincerity as a friend genuine.

Jette and I consider it a priviledge to have known him. Our lives have been enhanced considerably because of Herman's all too brief presence. We will miss you Herman.

Jette and Dwight Meglan
Mayo Clinic
Orthopedic Biomechanics Laboratory.

We will all have our personal memories of Herman and while this is a sad time I think that it is also an appropriate time to remember what kind of man he was. I recall asking questions on a variety of topics in the assumption that "Herman will know". Invariably Herman did know and inevitably proceeded to impart more than a normal person could assimilate in real time. I will miss our discussions, agreements and disagreements in equal measure and will long remember the one and only Herman Woltring.

Fred Yeadon

Dear Friends and Colleagues:

It is with great regret and deep sadness that I sit here this evening. Just a short while ago I logged on ready to continue an on-going dialog with Herman. Instead I find he has been snatched away from us leaving a void it will be hard to fill.

I first met Herman in 1979, when he served on my Doctoral Committee as an External Examiner. Our common interest in 3-D tracking brought us together, and in the years that followed we became good friends. I would often send him a note in the middle of the night, only to get an immediate response. He never rested.

We will all miss his contributions and his friendship. My

BIOLOCOMOTION:
A CENTURY OF RESEARCH USING MOVING PICTURES

edited by A.Cappozzo, M.Marchetti and V.Tosi
ISB Book Series - Volume 1
Promograph - Roma - Italy - 1992 - ISBN 88-86125-00-3
(hard bound, 356 pages, 180 black and white and 7 colour figures)

After a learned introduction by S.Cerquiglini, Part I of the volume illustrates the development of the concept of movement from the Greek philosophers to the Renaissance (G.Lorini et al.). The chapter on Borelli, the father of Biomechanics, by A.Cappozzo and M.Marchetti follows. Part II reviews the pioneering work carried out using moving pictures by Muybridge, Marey , Braune and Fischer, Bernstein, Eberhart and his associates, and others in the period of time which goes from 1878 to 1950. Relevant chapters are authored by V.Tosi, S.Bouisset, P.Maquet, H.-K.Galle, H.Jansons and J.P.Paul. Also included in this part is a chapter, by J.P.Clarys and L.Lewille, dealing with the work done by Duchenne de Boulogne and his predecessors on the recording and interpretation of the electrical activity in skeletal muscles. Part III presents, still in a historical perspective, the use of cinematography in biolocomotion both from the methodological point of view (H.J.Woltring) and in different fields of study, such as the assessment of musculo-skeletal disorders (R.A.Brand) and animal locomotion (R.McN.Alexander). Part IV is devoted to contemporary results obtained in different application contexts using moving pictures associated with electronic computers. I includes chapters by F.Greichen and G.Bergmann, T.Mittlemeier et al., A.Siemienski, J.Dul et al., F.Merni et al., M.Solari et al.
The volume is enriched with an extensive iconography part of which never published before.

price: Lit. 85,000 (ISB members: Lit. 63,750)
add Lit. 5,000 for surface mailing cost
add Lit. 18,000 for air mail

BIOLOCOMOTION:
A CENTURY OF RESEARCH USING MOVING PICTURES

edited by A.Cappozzo, M.Marchetti and V.Tosi
ISB Book Series - Volume 1
Promograph - Roma - Italy - 1992 - ISBN 88-86125-00-3
(hard bound, 356 pages, 180 black and white and 7 colour figures)

price: Lit. 85,000 (International Society of Biomechanics members: Lit. 63,750)

add Lit. 5,000 for surface mailing cost

add Lit. 18,000 for air mail

ORDER FORM

Please fill in and send to
Accademia di Scienze del Movimento
Istituto di Fisiologia Umana
Universita' degli Studi "La Sapienza"
00185 Roma - Italy
FAX: + 39 6 44 52 303

Surname: Name:

Mailing address:

Postal code: City: Country:

ACCADEMIA DI SCIENZE DEL MOVIMENTO

Please charge Lit. _____ to my (tick one box):

VISA ☐ MASTERCARD ☐ EUROCARD ☐

Card No. | | | | | | | | | | | | | | | | Expiry Date ___/___

Holder Name _____

Holder Date of Birth ____/____/____

Date _____ Signature _____

thoughts go out to his wife and family, for their loss is the greatest.

Herman, my friend, good night once again. May you rest in peace.

Jim Walton
4D VIDEO
Sebastopol, California.

Dear Colleagues,

I am one of many who came to know and admire Herman Woltring solely through this list. As I wrote to him recently, I have only a peripheral interest in the content of BIOMCH-L, but I have remained on the list just to participate vicariously in such an expertly edited international discussion, one which I told him was a model for anyone hoping to use the Internet to promote discussion and understanding, even of complex topics.

Like many of you who had the privelege of knowing him personally, I came to appreciate his thoroughness, his astonishingly prompt replies, and his good will and good humor. The Internet seems much less hospitable tonight, and we have all lost an invaluable colleague and friend.

Kindest regards to his family,

Daniel Updegrove
Associate Vice Provost
University of Pennsylvania.

Dear members of the biomechanics community,

As to all of you, the unexpected passing away of Herman Woltring was a shock also to me and my laboratory staff.

Although Herman and I had sometimes profoundly different opinions about certain issues, I always valued him as an intellectually brilliant scientist. His outstanding contributions in the fields of optimal data filtering and 3D-motion reconstruction from recorded optical images will certainly not be forgotten.

Finally, we would like to express our sincere condolence to his wife and children who suffer most from this tragic loss.

Herbert Hatze
and all his staff members,
Department and Laboratory of Biomechanics
University of Vienna
Austria.

Dear Networkers,

Herman Woltring was for our sub-department a very appreciated specialist in biomechanics and in the email-world. His advice about 3D-movement camera's was very useful for us. It was refreshing to read his daily scientific comments. We sincerely sympathize with his family on this tragic loss.

Brechtje Daams, Hans Dirken, Jozina de Graaf, Hans Houtkamp, Anton Jellema, Niels Moes, Johan Molenbroek, Guus van der Vaart

Department Engineering Anthropometry
Faculty Industrial Design Engineering
Delft University of Technology,NL

Dear BIOMCH-L readers,

The tragic death of Herman Woltring has come as a great shock and personal loss to me.

I have known Herman for almost twenty years and it was always a great pleasure to meet him at conferences and at other occasions. We had a special relation since we were interested in the same areas of biomechanics, and he really taught me a lot. Over the years, Herman was always like a living encyclopedia for me. He always knew all the references, and he kept a perfect track of what was going on at all biomechanics laboratories over the world. I also enjoyed his company very much on our numerous meetings.

Herman defended his PhD thesis on the same day as I did, on May 13, 1977. Since he defended his thesis in the morning, while mine was presented in the afternoon, he even took the opportunity to act as an external "telephone examiner" for my thesis, which is an example of the good humour he always showed.

I really want to express my deepest condolence with Herman's wife and children.

Hakan Lanshammar
Systems and Control Group
Uppsala University, Sweden.

IN MEMORIUM

- GIJS M. PRONK -

With deep sorrow we inform you of the death of dr. ir. G.M. (Gijs) Pronk (46). Gijs was killed last Monday on his way to work as the result of a train crash.

For those who have known Gijs, he will especially be remembered because of his enthusiasm for his work and his interest in the (biomechanics of the) human shoulder. With his enthusiasm and perseverance he managed to start up a, now healthy and promising, research line on the human shoulder. The fact that this line now spreads out over three diffeent universities and slants, only serves to illustrate his widespread interest and ability to bridge the so often existing gap between engineers and kinesiologists or between researchers and clinicians.

Those who were lucky enough to know him more personally, will also lose a very amiable easy-going friend who was always interested in the works and lives of others. We will miss him
dearly; his comments, ideas, plans, and above all, his friendship.

Gijs leaves behind Riees Willemsen, his partner and love for over twenty years. For her grief no words exist.

On behalf of his friends and colleagues,

Frans van der Helm.

Laboratory feature

The Center for Locomotion Studies

Pennsylvania State University
University Park, PA 16802, USA

THE PROGRAM

The Center for Locomotion Studies (CELOS) was founded in June of 1986 at the University Park campus of Penn State University to focus faculty and graduate student research efforts on the human locomotor system. Research Centers at Penn State have the responsibility to forge interdisciplinary links between departments and colleges throughout the University. CELOS provides both a well equipped gait laboratory and an intellectual forum in which research and scholarship can thrive. There are educational, research, and clinical thrusts in a wide-ranging program which has the study of the human locomotor system as its common denominator.

GRADUATE PROGRAMS

CELOS combines educational experiences, research, and clinical activities to help prepare students at the graduate level for careers in research, teaching, clinical science, or industry. Graduates earn the M.S. or the Ph.D. degree in Locomotion Studies as part of the graduate program in the Department of Exercise and Sport Science or a Ph.D. degree in the BioBehavioral Health Program.

Students come to the program with diverse backgrounds, including (but not limited to) physical therapy, rehabilitation medicine, computer science, mechanical engineering, bioengineering, exercise science, and the biological sciences. Coursework emphasizes a rounded preparation in both biological and engineering sciences together with courses in biomechanics, statistics, and a number of required areas. All degrees involve a research project culminating in a thesis.

CELOS offers students the opportunity to actively participate in both funded research and clinical evaluation under the direction of senior scholars from throughout the University, and practicing physicians and health care professionals from both the surrounding medical community and from Penn State and other academic institutions.

All major areas of research are currently funded by outside sponsors. Students are introduced to the concepts and requirements of funded research at an early stage in their educational experience. Two of our current graduate students are supported by fellowships from the National Institutes of Health.

Three courses are taught by CELOS faculty: Survey of Locomotion Studies; Biomechanics; and, Electromyographic Kinesiology. Students complete their coursework requirements by taking a variety of other courses both inside and outside of the College. A regular seminar program allows students the opportunity to present their own work and to listen to presentations by visiting scholars.

The 1992-1993 cadre of graduate students includes four doctoral candidates and seven masters candidates. Undergraduate honor students also have opportunities to conduct research at CELOS for their senior thesis.

Recent graduates have obtained positions at the National Institutes of Health and the Public Health Service; faculty positions at academic and medical institutions; and management/research positions at corporate biomechanical facilities in the U.S. and elsewhere.

In addition to support from University sources and funded research, The Irma and Harold Zipser Graduate Fellowship Endowment provides support for dissertation research or other activities for one graduate student annually.

An endowment funded by the Herbert A. and Jean V. Barron International Scholars Fund provides support for an international scholar to conduct research at the Center for up to six months.

RESEARCH ACTIVITIES

Researchers at CELOS study the biomechanics of human posture and gait, including the forces and the clinical consequences of deficits in the locomotor system. Locomotion studies at CELOS are interpreted in their broadest sense, encompassing elite, normal and pathological human gait, research in flooring and footwear, and fundamental studies of postural and locomotor mechanisms.

The Center is unique in its broad focus on a variety of populations including those with pathological gaits, the elderly, astronauts, people with diabetes, and other special populations.

In its first six years of operation, CELOS has received research support for such diverse topics as pressure distribution in the diabetic foot, studies of foot amputation, slip resistant surfaces, dually stiff flooring, posture and gait in the elderly, stress fractures in professional athletes, shoe testing, performance evaluation and design, and human locomotion in space. In addition to University support, over $2.5 million has been committed by a variety of sponsors including: the U.S. Department of Education; the American Diabetes Association; the Diabetes Research and Education Foundation; the Veteran's Administration; NASA; the National Institutes of Health; the AARP/Andrus Foundation; and private gifts to support research.

Ongoing research programs include:

- *The Biomechanics of the Foot* - the identification of relationships between form and function, including three-dimensional studies of foot morphology and radiographic studies of structure-function relationships.
- *Diabetic Foot Management* - the assessment of foot complications resulting from diabetes mellitus; the identification of risk factors which may result in foot injuries; the application of measurement techniques such as plantar pressure distribution to identify at-risk feet; and, the assessment of the functional aspects of various lower limb amputations. Drug studies of new "growth factor" approaches to wound healing are also underway.
- *Footwear in Diabetes* - the assessment of performance characteristics of various types of therapeutic footwear; the identification of special user needs; the analysis and modeling of the interface of the shoe and foot to determine optimal footwear design characteristics; and the evaluation of the efficacy of orthoses and orthopedic shoes in correcting gait and/or foot problems.
- *Reduced Gravity Locomotion* - the design and construction of a device to simulate zero gravity; the biomechanical assessment

of exercise modes to be used during prolonged space flight; studies of the normal loading and muscle activity of the lower limbs during normal activities on Earth and during space flight; and, the development and testing of gait training devices utilizing technical developments in zero gravity simulation.

- *Instrumentation for the Study of Gait and Posture* - the use of instrumented kinematic segments (IKS) to measure limb kinetics and kinematics. The development of shear stress transducers for plantar pressure measurement.
- *Posture and Falls in the Elderly* - the identification of normal gait and postural characteristics for healthy elderly; studies of environmental and visual factors relating to falls and the elderly; and, the assessment of the effects of alcohol on gait and posture in young and elderly subjects.
- *Effects of Alcohol on Gait and Posture in the Elderly*: to study the individual and combined effects of alcohol and reduced vision on locomotion in the elderly.
- *Dually Stiff Floors for Injury Prevention in the Elderly;* to conduct engineering analysis, biomechanical testing, construction, field testing and pilot intervention trails for a new flooring system that has the possibility to drastically reduce impact injuries that occur as a result of falls.
- *User Friendly Bus Interiors:* to develop design guidelines to increase rider comfort, safety, and vehicle utility levels by specifying the requirements that will allow a rider to maintain a maximum sense of balance and spatial orientation during standing on a moving bus.

CLINICAL ACTIVITIES

Clinical activities complement the research and teaching mission of CELOS. The main clinical focus is on diabetic foot management. Clinical services are intended to provide feedback to the patient and primary care physician concerning the role that the patient's gait, foot structure, and plantar pressure distribution play in foot injury. Center faculty are involved in two Diabetes Foot Clinics. One is in a local rehabilitation hospital and the other in the University Hospital at Penn State's Hershey campus. Although both clinics treat acute problems, they also stress prevention. The ultimate goals are the identification of patients at risk for the development of ulcers before they experience serious foot problems and the recommendation of a regimen of foot management to minimize future foot problems. Data from the clinics are collected in such a way that research studies can flow easily from a structured data base of history and treatment information.

The American Diabetes Association has endorsed a reference document titled *The Foot in Diabetes: A Bibliography.* This document, which includes nearly 1,800 entries, is financially supported by a pharmaceutical company, but developed and managed by the CELOS director and librarian.

FACULTY and STAFF

Peter R. Cavanagh, Ph.D., directs CELOS and serves as Research Director of the Diabetic Foot Clinics. His background includes both industrial and academic aspects of locomotion and gait issues. Dr. Cavanagh was the 1987 Wolffe Lecturer of the American College of Sports Medicine and winner of the 1987 Muybridge Medal of the International Society of Biomechanics. In 1988, he was one of four recipients of Penn State University's Faculty Scholars Medals.

Ge Wu, Ph.D., is an Assistant Professor of Biobehavioral Health who joined the CELOS faculty in July 1992 . She is a

CELOS Faculty, Staff and Students

Biomedical Engineer who came to CELOS from the Neuromuscular Research Center at Boston University (BU) where she had been conducting research on human joint loading estimation during locomotion. She recently led a research team at BU in the development of a biomechanical model of the human musculoskeletal system and in the design of an electromechanical device for accurately diagnosing low back pain.

Jan S. Ulbrecht, M.D., is an Adjunct Professor of Clinical Locomotion Studies and the Medical Director of the Diabetic Foot Clinic. He provides leadership in research related to diabetes and also maintains a private practice specializing in diabetes and endocrinology.

Janice Derr, Ph.D. is director of Penn State's Statistical Consulting Center and plays an important role as a consultant on all funded projects at CELOS. She holds office hours each week at CELOS and is available to students for consultation on biostatistical problems.

Faculty associates play an important role in both the research and graduate education aspects of the Center. CELOS attracts scholars from throughout the University including over twelve affiliate faculty from areas such as Psychology, Mechanical Engineering, Architectural Engineering, Biology, Biostatistics, Hershey Medical Center, Bioengineering, Statistics, Pennsylvania Transportation Institute, and Human Development and Family Studies. In addition, the Center has collaborative research projects with several major medical centers in the Eastern United States

Clinical, Technical, Administrative and Clerical Staff

The Center is fortunate to have an excellent infrastructure of clinical, technical, administrative and clerical staff. This includes a full time research nurse, an administrative assistant, a secretary, a receptionist/librarian, and three technical staff (two with Masters degrees in engineering). This team makes a high level of productivity possible and allows many projects to progress simultaneously.

FACILITIES

Laboratory: The Center for Locomotion Studies is housed in a 4,000 square foot area with a 100 foot instrumented runway. The space is divided into research, clinical and office areas to provide subjects with maximum privacy when participating in research activities. Handicapped access to the facility is available. Both electrical and mechanical workshop facilities are available within the Center.

Clinical: The clinic area includes a nurse/doctor office, two exam rooms, and an administrative office. A recovery room with bed and private bathroom is also available and this can serve as a small Clinical Investigations Unit. Shoe modification equipment including a grinder for therapeutic insole fitting is on site.

Computer: CELOS operates a Micro Vax II which is networked via Ethernet to an SMS 1000 (a PDP 11-73 clone). The SMS has the capability for high speed analog to digital conversion of up to 16 channels of data. Most data collection is, however, done on a Macintosh II fx platform using Labview Software. A Tektronix graphics workstation 4336 and color printer also support data analysis. The office environment operates on Macintosh equipment and the entire Center is networked via Appletalk to the VAX, other workstations, and a laser writer. Modem hook-ups allow access to Compuserve, the National Library of Medicine, Penn State Library, Bitnet, and to the University's central IBM mainframe. Finite element analysis software is available in the Center (I-DEAS, ABAQUS, and ANSYS).

Gantry: A safety harness attached to a 40' gantry is installed in the Center directly over the force platform to insure subject safety during testing. The safety harness limits a fall to 6". Walking, standing, and stair negotiation are all possible while wearing the harness. Controlled lighting is installed alongside the gantry as well as movable partitions to limit the quality and amount of light available to subjects during testing and to alter the visual environment.

Penn State Zero-Gravity Simulator (PSZGS): A device has been designed and built to facilitate the biomechanical evaluation of various forms of exercise that are typically performed by astronauts in a zero-gravity environment. It is anticipated that this device will throw new light on the possibilities for exercise countermeasures for the problem of space flight induced osteoporosis which currently poses a threat to long-term space missions.

Major Equipment: CELOS is equipped with two Kistler force platforms, a Quinton treadmill, a 1000 element piezoelectric pressure distribution measuring device, a Novel SF capacitance pressure measurement device, high speed cinematography and digitizing equipment, Selspot and Peak Performance motion analysis systems, Integrated Kinematic Sensors, Nerve Conduction Velocity Testing Device, instrumented stairs, 6 channel EMG amplifier (non telemetric), TekScan and Novel in-shoe pressure measuring device, sensation testing equipment including a vibrometer and monofilament testing materials, foot surface contouring device and foot volume measuring device. A balance disturbance system has also recently been added to the tools available.

If you are interested in further information regarding CELOS, please contact:

Peter R. Cavanagh, Ph.D.
Center for Locomotion Studies
Penn State University
University Park, PA 16802
USA

Tel: 814-865-1972
FAX: 814-863-4755
Email: PRC@ECL.PSU.EDU

Some recent publications by Center faculty and students are shown below:

Ladin, Z. and Wu, G. "Combining Position and Acceleration Measurements for Joint Force Estimation". **Journal of Biomechanics**, 24(12):1173-1187, 1991

Wu, G. and Ladin, Z. "The Kinematometer - An Integrated Kinematic Segment For Kinesiological Measurements". **Journal of Biomechanical Engineering**, 1993 (in press)

Wu, G. and Ladin, Z. "The Evaluation of Human Joint Load Estimation Methode Through a 2-D Pendulum Model". **Electromyographical Kinesiology.** Edited by P.A. Anderson, D.J. Hobart and J.V. Danoff. Elsevier Science Publishers, 1991, pp. 205-208

Cavanagh, P. R.; Davis, B. L.; Miller, T. A. A biomechanical perspective on exercise countermeasures for long term space flight. Aviation, Space and Environmental Medicine. 1992; 63(6): 482-485.

Cavanagh, P. R.; Derr, J. A.; Ulbrecht, J. S.; Maser, R. E.; Orchard, T. J. Problems with gait and posture in neuropathic patients with insulin dependent diabetes mellitus. Diabetic Medicine. 1992; 9(5): 469-474.

Cavanagh, P. R.; Sims, D. S. , Jr.; Sanders, L. J. Body mass is a poor predictor of peak plantar pressure in diabetic men. Diabetes Care. 1991; 14(8): 750-755.

Cavanagh, P. R.; Simoneau, G. G.; Ulbrecht, J. S. Ulceration, unsteadiness, and uncertainty: the biomechanical consequences of diabetes mellitus. In Press, Journal of Biomechanics. 1993.

Cavanagh, P. R.; Ulbrecht, J. S. Biomechanics of the diabetic foot: a quantitative approach to the assessment of neuropathy, deformity, and plantar pressure. In: Jahss, M. H., Ed. Disorders of the Foot & Ankle. 2nd ed. Philadelphia, PA: W.B. Saunders; 1991; II, Chapter 66: 1864-1907.

Cavanagh, P. R.; Ulbrecht, J. S. Plantar pressure in the diabetic foot. In: Sammarco, G. J., Ed. The Foot in Diabetes. Philadelphia, PA: Lea and Febiger; 1991: 54-70.

Simoneau, G. G.; Cavanagh, P. R.; Ulbrecht, J. S. The influence of visual factors on fall-related kinematic variables during stair descent by older women. Journal of Gerontology: Medical Sciences. 1991; 46(6): M188-M195.

Simoneau, G. G.; Leibowitz, H. W.; Ulbrecht, J. S.; Tyrrell, R. A.; Cavanagh, P. R. The effects of visual factors and head orientation on postural steadiness in women 55 to 70 years of age. Journal of Gerontology: Medical Sciences. 1992; 47(5): M151-158.

Announcements

BIOMECHANICS POSITIONS AVAILABLE

ASSISTANT PROFESSOR
Program of Human Biodynamics
Division of Biological Sciences
University of California, Berkeley

Applications are invited for a tenure-track Assistant Professor position starting July 1, 1993. Candidates should have demonstrated excellence, originality, and productivity in biomechanics and should have strong interests in undergraduate and graduate teaching. Research areas of interest may range from single cells to muscle systems to intact organisms; they may include, but are not limited to, mechanics of biomaterials and tissues, muscle mechanics and energetics, regulation of contraction, cardiovascular biomechanics, musculo-skeletal biomechanics, and movement biomechanics.

Applications, including a curriculum vitae, a list of publications, a reprint of the three most significant publications, a brief (two pages maximum) statement of research and teaching objectives, and three letters of evaluation should be sent to:

Professor Timothy P. White, Chair,
103 Harmon,
University of California,
Berkeley, CA 94720.

The closing date for receipt of applications is January 29, 1993. The University of California is an Affirmative Action/ Equal Opportunity Employer. Women and members of under-represented minorities are especially encouraged to apply.

PHYSICAL THERAPIST WITH AN INTEREST IN GAIT ANALYSIS

Siskin Hospital for Physical Rehabilitation is looking for a Physical Therapist to perform gait analyses and be responsible for the daily operations of a newly opened gait lab. This individual will work closely with the Director of the gait lab, Dr. Michael Whittle, who holds the Cline Chair of Rehabilitation Technology in the University of Tennessee at Chattanooga.

A minimum of three years of experience is required with experience in neurological disorders preferred. Knowledge of computers beneficial. Please direct resumes and/or phone calls to:

Pam Turner, Director of Physical Therapy, or
Diana Brown, Director of Human Resources.
Siskin Hospital for Physical Rehabilitation
One Siskin Plaza
Chattanooga, Tennessee 37403
U.S.A.
Tel: +1-615-634-1200
(An Equal Opportunity Employer)

TEACHING FELLOWSHIP IN BIOMECHANICS

Department of Human Movement Science
The University of Wollongong
Australia

For the period February to July, 1993.

The successful applicant, depending on their qualifications and experience, would be expected to teach in either an introductory undergraduate class in Qualitative Biomechanics or a graduate class in Advanced Biomechanics. The applicant would also be expected to contribute to the Department's research program, which focuses on musculoskeletal injury mechanisms (particularly in the lower extremity).

A well-defined and systematic undergraduate teaching program servicing both Human Movement and Physical Education students follows through to specialist graduate subjects in Advanced Biomechanical Techniques and Occupational Biomechanics. The Department has a well-equipped biomechanics research laboratory and strong collaborative links with other departments, including Mechanical Engineering and Materials Engineering.

The University of Wollongong is a young, rapidly growing institution of approximately 9000 students. Its campus is situated between the forested escarpment and a string of magnificent ocean beaches and neadlands. The city of Wollongong has a population of 250,000 and is located 80 km south of Sydney, Australia's largest city, which is easily accessible by car or public transport.

A remuneration package of $A10,000 is payable either in the form of salary or a combination of airfares, accommodation and salary.

Interested persons should submit an application before 18th December, 1992 to:

Dr. Peter Milburn
Head, Department of Human Movement Science
The University of Wollongong
Northfields Avenue,
Wollongong, NSW 2522
AUSTRALIA
Tel: (+61 42) 214161
Fax: (+61 42) 214096
E-mail: peter milburn@ms-gw.uow.edu.au

CHANGE OF JOURNAL NAME

Human Kinetics Publishers have announced that the name of the *International Journal of Sport Biomechanics* will be changing to the ***Journal of Applied Biomechanics (JAB)***. The mission of the new journal is to publish articles that pertain to the applied aspects of human biomechanics in sport, exercise, and rehabilitation. More specifically, research examining the effect and control of forces that act on and are produced by the human body and studies related to modelling and human movement simulation and the effects of internal and external forces on body structures during skill development and rehabilitation are appropriate for JAB,

Thesis abstracts

COORDINATION OF THE ARM DURING THE ACQUISITION OF A NOVEL, MULTIJOINT THROWING SKILL

by

Gary D. Heise

Department of Exercise and Sport Science
The Pennsylvania State University
Degree: Doctor of Philosophy

Supervisor: Professor Richard C. Nelson

The primary purpose of this investigation was to determine, with a kinetic-based approach, if individuals produce more joint power and if they redistribute or transfer more power during the acquisition of a planar, multijoint, throwing skill. A secondary purpose concerned the neuromuscular control process and the coordination ofmuscle activity of opposing sets of agonist-antagonist muscle pairs during skill acquisition. Specifically, the secondary purpose was to determine if the onset of muscle activity, the duration of muscle activity, the duration of muscle coactivation, and the amplitude of muscle activity changed during practice.

Eighteen right-handed men volunteered as subjects and performed a planar, three-joint movement involving their dominant arm. Subjects threw a weighted tennis ball (0.67 kg) at a target positioned 3.5 m away on the floor. The movement of the throwing arm was accomplished in a horizontal plane by having subjects slide their arm across a smooth platform. Each subject performed 55 throwing trials and the resultant absolute error, which is an indication of performance, was measured. The horizontal throwing motion of 25 trials, which consisted of 5 trial blocks of 5 trials each, was videotaped with a camcorder operating at 60 Hz with an exposure time of 0.001 s. From the video data and body segment inertial estimations, the instantaneous rate of energy transferred by the joint reaction force and the instantaneous joint power attributed to the net joint moment were calculated. The joint power analysis yielded the amount of power generated by musculature and the rate of energy transferred through muscle. Electromyography (EMG) was used to measure the muscle activity of six muscles involved in the throwing motion: anterior deltoid, posterior deltoid, biceps brachii, triceps brachii, wrist flexors, and wrist extensors. These data were collected at 600 Hz, synchronized with video data, full-wave rectified, and then low-pass filtered. Dependent measures were statistically tested with a repeated measures multivariate analysis of variance.

Absolute error score results showed an expected improvement over trial blocks. Subjects displayed rapid improvement over the first two trial blocks and no significant differences were noted over the last three trial blocks. Maximum mechanical power generated by the joint moment showed that the elbow extensor musculature was the dominant power source for the movement. The horizontal abductor of the

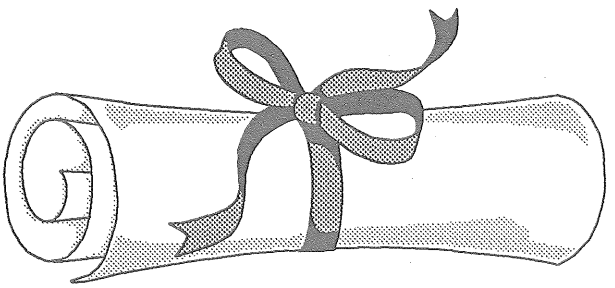
shoulder generated less power than the elbow extensors and the musculature at the wrist generated virtually no power. The maximum elbow joint power displayed the most changes across practice trials as compared to other joint powers. Some mechanical power was transferred through the musculature at the wrist and elbow, but few changes were noted across practice. The majority of power delivered across the wrist joint was due to the joint reaction force and changes were noted early in practice.

The temporal pattern of power generation and transfer at the joints displayed a proximal to distal (P-D) sequence. This sequence was considered an invariant characteristic of the movement. The EMG results supported this invariant temporal feature of the throw since the onset of muscle activity and the duration that each muscle was active, expressed as a percent of movement time, did not change over practice. The coactivation of agonist-antagonist pairs of muscles also did not change over practice.

Collectively, these results showed that subjects did not alter their degrees of freedom as suggested by Bernstein (1967). No changes in the duration of coactivation of agonist-antagonist pairs were found. The pair of muscle groups across the wrist joint showed the highest degree of coactivation, which demonstrated that individuals constrained movement at that joint throughout practice.

The most notable change in amount of muscle activity occurred at the elbow extensor, triceps brachii. Increases in overall activity seen over the first three trial blocks occurred concurrently with increases in the mechanical work done on the forearm by the elbow extensor moment. This similarity between the change in mechanical output and the change in EMG activity was not shown for any other muscle group.

It was concluded that joint power increased significantly at the elbow and shoulder during practice. The rate of energy transfer by the joint reaction force increased significantly at the wrist and the rate of energy transfer through muscle increased at the elbow and wrist during practice. EMG changes over practice were limited to amplitude measures. No changes were observed for the time of muscle activity onset, the duration of muscle activity, or the duration of coactivation of agonist-antagonist muscle pairs during practice.



THE INFLUENCES OF FATIGUE ON HYPOTHESIZED MECHANISMS OF INJURY TO THE LOW BACK DURING REPETITIVE LIFTING

by

James Robert Potvin

A thesis presented to the University of Waterloo
in fulfilment of the
thesis requirement for the degree of
Doctor of Philosophy
in
Kinesiology

Waterloo, Ontario, Canada, 1992

Supervisor: Professor Robert K. W. Norman

There is evidence to suggest that fatigue can predispose tissues to a higher risk of injury but little data to indicate what injury risk enhancing effects fatigue may have on lifting mechanics. The purpose of this study was to determine whether fatigue caused by repetitive lifting increased the risk of damage to low back tissues as measured by changes in the demands on muscles, ligaments and other spinal structures.

Eight male subjects lifted repetitively in the sagittal plane. There was a 20 minute lifting session of relatively high intensity (8 lifts/minute, average load of 20 kg) and a longer session lasting 2 hours at a lower intensity (6 lifts/minute, average load of 18 kg). The subjects performed dynamic lifting movements with an unconstrained, hand held, inertial load.

It was critical to establish that the subjects were becoming fatigued before fatigue was used as a factor to explain the changes observed in the dynamic lifting mechanics of each individual. Peripheral and/or central fatigue were quantified intermittently in a test contraction apparatus with strength measures and EMG statistics measured during submaximal, isometric contractions as well as a test of trunk extensor muscle endurance at the end of each session. Changes hypothesized to accompany fatigue were generally observed in the group mean values over the duration of each session (decreased maximum moment by 20%, endurance time by 60%, and EMG MnPF by 16-21% and increased EMG amplitude by 37-122%) although there were some cases where individual subjects did not show conclusive signs of fatigue during the short session. The main strengths of this technique were that it used multiple measures to quantify both the existence and the extent of fatigue.

Hypothesized mechanisms of low back injury were addressed by monitoring changes in erector spinae muscle forces, leg and abdominal activations and extensor ligaments utilization. Three dimensional spine kinematics were used to estimate lumbar joint rotations and ligament lengths. Erector spinae muscle forces were estimated for a combination of motor unit activation, length and velocity changes over the whole duration of each session.

The most significant finding of this study was that particular individuals exhibited changes in lifting mechanics

which may have put them at a higher risk of injuring low back tissues if they were to perform the task for prolonged periods of time. There were no variable which showed the same trend for all subjects in either session although there was a significant decrease in the group average of mean and peak vastus lateralis EMG in both sessions and a significant increase in peak spine flexion angle in the 20 minute session. These results indicated a tendency for subjects to reduce the demands on the lower extremities and to flex the trunk more as they became fatigues. There were subjects who showed a progressive and risky increase in the demands on passive extensor structures during both the long and short sessions as indicated by increased spine flexion and an increase in the flexion-relaxation response. In addition, most of the subjects exhibited a change in at least one of the other variables hypothesized to be associated with injury (increased compression forces, decreased lumbar shear support, increased coupled moments and loading asymmetries) during the lifting tasks. The differences observed between subjects and within sessions demonstrated the sensitivity of the data collection and analysis method to changes in lifting mechanics and tissue loading during long duration, repetitive lifting.

To address the purpose of this study it was necessary to develop a protocol and analysis method that would 1) fatigue subjects, 2) quantify the fatigue and 3) estimate its tissue loading consequences on a continuous basis during dynamic lifting tasks. Based on the findings of this analysis, it was concluded that individuals differed in their susceptibility to low back injuries during fatiguing dynamic lifting. Some subjects maintained consistent lifting mechanics, even in the presence of quantified trunk fatigue, while others responded by adopting mechanics which have been hypothesized to increase the risk of damaging the posterior ligaments, intervertebral discs, vertebral bodies and/or erector spinae muscles.

FORCE-TIME CHARACTERISTICS OF MAXIMAL AND SUBMAXIMAL ISOMETRIC MUSCULAR ACTIONS

by

Somadeepti N. Chengalur

Dissertation Abstract for Doctor of Philosophy
Department of Exercise & Sport Science, Biomechanics Laboratory, Penn State

Advisor: R. C. Nelson, Ph.D.

The purpose of the present investigation was to investigate the force-time curves obtained from isometric muscular actions of elbow flexors and extensors to determine if a similar system can be used to differentiate between maximal and submaximal efforts. The current study also investigated whether or not bilateral muscle action would bring out more clearly the difference between maximal and submaximal efforts. In addition, the effect of increasing the complexity of the task, by performing a different effort level with each hand, was also investigated.

Data from a total of 32 males and 32 females between the ages of 20 and 45 were analyzed for this study. All 64 subjects performed bilateral grip tests. The subjects were randomly assigned to two groups (consisting of an equal number of men and women), one which performed elbow flexion tests and one which performed elbow extension tests. The subjects were seated in a chair which was adjusted so that either the forearms (grip test) or the upper arms (elbow flexion and extension tests) could be rested horizontally on the table top, with the elbow at a 90 degree angle. The upper body was maintained in an upright position and was strapped in with belts (waist and shoulder) to minimize any movement which would affect force production.

For each test, the subjects performed four sets of tests which were: bilateral maximum effort, bilateral submaximal effort, and two bilateral alternating tests. Force was assessed during steady exertion lasting for five seconds. The mean and standard deviations were determined for a number of variables (peak force, average force, and five discriminators: D1, D2, D3, D4 and D5), calculated from the force-time data. The data were divided into bilateral grip data, elbow flexion data and elbow extension test data for analysis. The data were further subdivided in terms of gender. The same statistical procedures were followed for each data subset. An ANOVA was performed on each subset to determine if the maximal and submaximal data were significantly different from each other. The effect of performing bilateral tests as opposed to unilateral tests was also investigated and the impact of performing different tasks with each hand was examined.

From the results of the current study it could be concluded that the difference in force-time pattems observed between maximal voluntary muscular actions and submaximal voluntary muscular actions in unilateral grip testing were observed in data from strength tests of the elbow joints. This was true for both men and women. In addition, bilateral testing emphasized the difference between maximal and submaximal efforts, in terms of the variability of the force time curves. This was statistically significant for the male subjects only, although the data from the female subjects showed a similar trend. Finally, performing different levels of effort with both hands increased the variability of the submaximal efforts for the flexion tests (for both men and women) and extension tests (for the men only).

Logistic regression models indicated that the discriminators could be used with a high degree of accuracy to detect submaximal efforts. Prediction accuracy for the bilateral grip tests and the extension tests was greater than that for the flexion tests. An objective, reliable and simple system of classification of effort levels could therefore be developed based on the defined discriminators.

Conference news

BIOMECHANICS SYMPOSIUM

First Joint ASCE-EMD, ASME-AMD, SES Meeting
June 6-9, 1993 Charlottesville, Virginia

Original abstracts are solicited on traditional areas of Biomechanics. Topics include, but not limited to: Biomechanics; Cardiovascular Mechanics; Soft Tissue Mechanics; Trauma and Impact Biomechanics; Biomechanics of Musculoskeletal System and Biorheology.

Submit one-page abstract by January 15, 1993 to:

J. Vossoughi
Engineering Research Institute
University of the District of Columbia, 4200
Connecticut Ave NW, Washington, DC 20008
USA
Tel: (202) 2822388; Fax: (202) 282-3677.

All accepted abstracts will be published in the Conference Proceedings volume which will be available at the meeting.

THE SECOND INTERNATIONAL WORKSHOP ON ANIMAL LOCOMOTION (SIWAL)

To be held 12-14 March 1993 in Southern California, USA.

The first workshop of this type was a highly successful working gathering of scientists at Utrecht, The Netherlands, in 1991. It attracted an outstanding international array of researchers in a variety of interdisciplinary fields relating to the locomotion of animals.

SIWAL-California will be held in conjunction with the annual conference of the Association for Equine Sports Medicine, 14-16 March, 1993.

The most productive and popular aspect of this workshop has been an emphasis on practical exchanges of research techniques, informal interactions, and hands-on demonstrations of innovative research and new technologies.

For more information, please contact:

Dr. Hilary Clayton
Dept. of Veterinary Anatomy
Western College of Veterinary Medicine
University of Saskatchewan
Saskatoon, Saskatchewan S7N 0W0
CANADA
E-Mail: clayton@sask.usask.ca
Tel: 306/966-7408
Fax: 306/966-8747

CALL FOR ABSTRACTS

8th East Coast Clinical Gait Conference
Hosted by: Orthopedic Biomechanics Laboratory
Mayo Clinic/Mayo Foundation
Rochester, MN

May 5-9, 1993

Many of the past participants in The East Coast Clinical Gait Conference and the West Coast Clinical Gait Conference have joined together in an effort to share common interests and problems. As a result, this conference has experienced impressive growth over the last few years. Participants have come from all segments of the USA, from Canada, and even Europe. This year we look forward to continued participation from all regions as we move from regional meetings to a combined North American Gait Conference.

We will be pleased to receive original abstracts in the biomechanics of human movement with emphasis on gait. Please use the following format for preparation of abstracts. To assure the highest quality available, please submit material via mail only. Abstracts will be reproduced as received.

All abstracts concerning gait and gait analysis are welcome. Special consideration will be given to abstracts that illustrate unique uses of gait analysis, clear and concrete benefits of gait analysis that cannot be obtained by other means, and abstracts that provide a vision of the future of gait analysis such as new equipment and techniques.

Instructions for Authors:

Maximum of two 8 1/2 x 11 inch pages, including references, figures, and tables.
Single space with a blank line between paragraphs.
Indent 5 spaces for first line of paragraph.
One inch margin on all sides
Main headings - centered, capitalized
Subheadings - at left margin
Title includes authors and affiliations
Authors' names and page numbers on back of each page in pencil

Additional information may be obtained by contacting:

Tom Cahalan, P.T. -or- Dwight Meglan, Ph.D.
Orthopedic Biomechanics Laboratory
Mayo Clinic/Mayo Foundation
Rochester, MN 55905
Tel: (507) 284-8941
Fax: (507) 284-5392

Deadline dates:

Submission of Abstracts: January 29, 1993
Notification of Authors: March 1, 1993

Calendar of scientific events

April 1-2, 1993
International Seminar on Biomechanics and Joint Replacement in the Upper Limb, London. Contact: Conferences Services, IMechE Headquarters, 1 Birdcage Walk, London SW1H 9JJ, U.K.
Tel: +44 71 973 1318/1316; Fax: +44 71 222 9881; Telex: 917944.

April 2-4, 1993
Twelfth Southern Biomedical Engineering Conference, Tulane University, New Orleans, Louisiana, USA. Contact: Dr. Kirk J. Bundy, Biomed. Eng. Dept., Tulane University, New Orleans, Louisiana 70118, USA. Tel: (504) 865 5897.

June 14-18, 1993
IEA World Conference on Ergonomics of Materials Handling, Warsaw, Poland. Contact: EMH '93 Secretariat, Center for Industrial Ergonomics, University of Louisville, Louisville, KY 40292, USA.
Tel: +1 (614) 292-6670; Fax: +1 (614) 292-7852; E-Mail: marras@CCL2.Ohio-state.edu

June 30 - July 3, 1993
Second International Symposium on 3-D Analysis of Human Movement, Poitiers, France. Contact: Paul Allard, PhD, International Symposium on 3-D Analysis
of Human Movement, Centre de recherche Hôpital Sainte-Justine, 3175 Côte Ste-Catherine, Montréal, PQ, H3T 1C5, Canada. Tel: +1(514)345-4740; Fax: +1(514)345-4801; E-mail: aissaoui@ere.umontreal.ca

June 30 - July 2, 1993
IVth International Symposium on Computer Simulation in Biomechanics, Paris France. Contact: B. Landjerit, Laboratoire de Biomécha niique, E.N.S.A.M., 151 Boulevard de l'Hôpital, 75013 Paris, France. Tel & Fax: 33.1.44.24.63.65.

July 4-8, 1993
XIVth Congress of the International Society of Biomechanics (ISB), Faculté de Médicine Pitié-Salpêtrièe, Boulevard de l'Hôpital, Paris 13e, France. Congress Office: Convergences - I.S.B. '93, 120, avenue Gambetta, 75020 Paris, France. Fax: (33-1) 40.31.01.65; Telex: 216911 F.

July 10-15, 1994
Second World Congress of Biomechanics, Amsterdam, The Netherlands. Congress Office: Biomechanics Section, Institute of Orthopaedics, University of Nijmegen, PO Box 9101, 6500 HB Nijmegen, The Netherlands. Tel: +31-80-613366; Fax: +31-80-540555.

ISB membership news

NEW MEMBERS

OGISO, Kazuyuki
Toba National College of
Maritime Technology
1-1, Ikegami-cho
Toba City, Mie Prefectue 517
JAPAN (#1406)

MARGULIES, Susan S.
Thoracic Diseases Research
Mayo Clinic
4-411 Alfred Building
Rochester MN 55905
USA (#1407)

NOFFAL, Guillermo J.
Department of Human Movement
The University of Western Australia
Nedlands, WA 6009
Parkway
Nedlands, WA 6009
AUSTRALIA (#1408)

TOKUHARA, Yasuhiko
Biomechanics Lab
Osaka International University
for Women
6-21-57 Tohdacho, Moriguchi
Osaka 570
JAPAN (#1409)

HAYASHI, Kozaburo
Research Institute for Electronic Sci.
Hokkaido University
N12 W6
Sapporo 060
JAPAN (#1410)

CROCE, Ugo Della
Istituto Fisiologia Umana
Universitá "La Sapienza" Di Roma
P. Le Aldo Moro 5
Rome I 00185
ITALY (#1411)

BERGER, Monique
Dept. Ex. Physiol. & Biophysics
Faculty of Human Movement Studies
Vrije Universiteit
v.d. Boechorststaat g
Amsterdam 1081 BT
THE NETHERLANDS (#1412)

BAKKER, Christa
Dept. of Ex. Physiol. & Biophysics
Faculty of Hunam Movement Studies
Vrije Universiteit
v.d. Boechorststaat g
Amsterdam 1081 BT
THE NETHERLANDS (#1413)

POTVIN, Jim
School of Human Biology
University of Guelph
Guelph, Ontario N1G 2W1
CANADA (#1414)

HRYSOMALLIS, Con
Physical Education and Recreation
Victoria University of Technology
8 Percy Street
Prahran VIC 3181
AUSTRALIA (#1416)

ANGULO, Teresa
M.D Ph.D
Universidad Complutense de Madrid
Diego de Leon No 45 (5A)
28006 Madrid
SPAIN (#1418)

POWER, Bruce M.
Human Movement
University of Wollongong
7/20 Penison Street
Wollongong NSW 2500
AUSTRALIA (#1419)

BURNETT, Angus
Human Movement
UWA
Parkway
Nedlands WA 6009
AUSTRALIA (#1420)

DART, Jolene A.
Human Kinetics
University of Wisconsin
1127 E. Walworth St Apt 1
Milwaukee WI 53212
USA (#1421)

LAURENCE, Cheze
Department of Mecanique
Universite Claude Bernard
43 Bd du 11 November - Bat 710
Villeurbanne
FRANCE 69622 (#1422)

ANTOLIC, Vane
Department of Orthopaedic Surgery
University Medical Center
Zaloska 9
Ljubljana
SLOVENIA 61000 (#1423)

LAVANDEIRZ, José R. B.
Rendimieuto Deportivo
INEF - Galicia
Universidad La Coruna
Avenida De Los Mallos 56
La Coruna
SPAIN 15007 (#1424)

BEER, Randall F.
Department of Biomedical Engineering
Northern University
2175 South Tonne Dr #221
Arlington Heights, IL 60005
USA (#1425)

SAGGINI, Raoul
Department of Sports Medicine
University of Chieti
Vie Rondinelli 3
Florence
ITALY 50123 (#1426)

KUSTER, Marcus
Werdstr. 5
Dietoldsam, CH 9444
SWITZERLAND (#1428)

MCLAUGHLIN, Patrick A.
Department of Phys. Ed. and Recr.
Victoria University of Technology
P.O. Box 14428 M.M.C.
Melbourne, VIC 3000
AUSTRALIA (#1429)

QUESNEL, Thierry
Department of Biomechanics
Laboratoire d'Anatomie, Granje-Blanche
Université Lyon I
509 Rue Buet, Chambery
FRANCE 7300 (#1430)

VALERO-CUEVAS, Francisco J.
Department of Mechanical Engineering
Stanford University
Barnes 7E, Escondido Village
Stanford, CA 94305
USA (#1431)

SUMER, Aykut
Department of Biomedical Engineering
Rutgers
The State University of New Jersey
57 Nichols Apts.
Piscataway, NJ 08854
USA (#1432)

DEUEL, Nancy R.
Equine Sports Biomechanics Lab.
University of Maryland
1113 Animal Sciences Ctr.
College Park, MD 20742
USA (#1433)

ANDREWS, David M.
113 Moore Ave. S.
Waterloo, ON N2J 1X3
CANADA (#1434)

REINSCHMIDT, Christoph
Human Performance Lab.
Faculty of Physical Education
The University of Calgary
2500 University Drive NW
Calgary, Alberta T2N 1N4
CANADA (#1435)

GRABINER, Mark D.
Dept. of Biomed. Engineering
Cleveland Clinic Foundation
9500 Euclid Avenue
Cleveland, OH 44195-5254
USA (#1436)