International Society of Biomechanics Newsletter

ISSUE Number 44, NOVEMBER / DECEMBER 1991

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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; Japanese Society of Biomechanics; Korean Society of Biomechanics; Polish Society of Biomechanics; Sports Commission of the Soviet Union.

ISB news

PRESIDENTS' MESSAGES

FROM THE RETIRING PRESIDENT: Bob Norman

Time flies! I have been in office for almost 2½ years and am about to turn over the Presidency to Professor Cappozzo. The time has been eventful. I would like to review some of the activity of the Council over this time and acknowledge some people who have done exceptional work for the Society. All are volunteers and almost all making their contribution to the ISB completely at their own expense.

Dick Nelson and Cathy Heise have revised the ISB brochure, continued to work on keeping annual fees and registration up to date, and have implemented a form to help keep track of member scientific interests. Don Chaffin has revised the Constitution and the Operating Codes for Officers of the Society. The organization of the ISB is in good shape. Micheline Gagnon has produced a draft outline for a possible ISB monograph on "Tri-dimensional Analysis of Human Movement: Methodological Problems and Applications". The Council has to decide whether the ISB can afford to produce it and whether the topic is right for this point in time.

Erich Schneider has organized the New Investigator and Clinical Biomechanics Awards competition and, along with a number of others, has reviewed many two page mini-papers and full manuscripts. Ron Zernicke has made another arrangement with the Journal of Biomechanics for publishing abstracts of the Perth Congress in a regular issue and the invited papers in a special issue. Peter Cavanagh has continued to work on standardization of terminology and conventions in locomotion research.

Dewey Morehouse could not escape the Society, even in retirement. He has set up a system at Penn State University in the USA to archive ISB materials for historical purposes. Anyone who may have early society materials is requested to send them to Professor Morehouse at the address of the Treasurer. We have two very active working groups, one now chaired by Jan Clarys, The World Commission on Sport Biomechanics, the ISB voice in this area of biomechanics. The other is the Working Group on Computer Simulation in Biomechanics, chaired by Andrzej Komor before his untimely death and, graciously, taken over on an interim basis by Mont Hubbard.

The Muybridge Medal committee was chaired by Paavo Komi. After reviewing 13 highly qualified nominees, the committee unanimously selected Professor R. McNeill Alexander of the Department of Pure and Applied Biology at the University of Leeds, England. This award is the highest that the ISB offers. It is for major contributions to biomechanics as evidenced by a balance of good scientific publication and methodological development and application. Professor Alexander has a continuing record of outstanding work on many aspects of animal locomotion, published in numerous journals and books over nearly 25 years. His is, indeed, a major contribution to the science of biomechanics. He will speak on "Optimization of structure and movement of the legs of animals".

Considerable debate inside and outside the Council, and a great deal of my time, was spent on addressing the issue of the role, if any, of the ISB in future World Congresses of Biomechanics. The ISB has decided to make a contribution to this effort because doing so is in the best interests of the development of the scientists and the science of biomechanics. I am representing the ISB on a subcommittee of the World Congress Steering Committee whose mandate is to investigate the possibilities for forming an international group for promoting all aspects of biomechanics and for the continuation of the World Congress of Biomechanics. In addition, the ISB has been asked to organize a symposium or two to be held at the next World Congress in Amsterdam in 1984. Thus, the ISB will play a role in this forum.

The first ISB Promising Scientist Grant of $1500 U.S. was awarded to Daniel Pflaster, currently studying with Malcolm Pope at the University of Vermont in the USA. He will use the money to assist with his travel to work with Dr. Alice Maroudas at the Israel Institute of Technology on a project involving the swelling of intervertebral discs.

Finally, I wish to mention the outstanding work of Graeme Wood and those who assist in Perth for carrying on the onerous task of producing a high quality newsletter four times a year. The Perth people have done this on top of the task of organizing the 13th Congress of the ISB and deserve the appreciation of all of us. The Newsletter is the primary forum for communication amongst the membership and between the members and the Council. I urge you all to contribute to the newsletter so that issues of interest to you are brought before the membership for information exchange and healthy debate.

I have made many friends in many countries over many years of involvement in the ISB. I have been honoured to attempt to serve you as President and wish Aurelio Cappozzo, the Council and the membership at large, well in the future. To all who have assisted, I thank you for your support.

Bob Norman

FROM THE INCOMING PRESIDENT: Aurelio Cappozzo

Dear Friends,

The International Society of Biomechanics, while approaching the twentieth anniversary of its foundation, is exhibiting increasing vitality which is accompanied by an ever increasing interest in biomechanics within the scientific and professional communities. Important results, both heuristic and practical, have been obtained in recent years. In addition, Biomechanics has helped establishing a more appropriate and effective language and philosophical approach to the open problems. In this respect, professionals have drawn a great deal of benefit from the continuous debate going on among biomechanicians concerning their practical problems. I think that everybody acknowledges that ISB has had a vital role in pursuing this objective. The published proceedings of its biennial congresses, the Newsletter, the patronage and the active presence of the Society members in other scientific events held worldwide testimony this fact. Equally important are the Awards which are given by the Society, especially the Muybridge Award which is bound to be recognized as the most prestigious worldwide in our field.

A new important enterprise is being undertaken by our Society. This is the production of a Series of volumes in biomechanics which aims at setting the milestones of the development of this discipline. The first volume will be ready by the end of this year. Its title is "Biolocomotion: a Century of Research Using Moving Pictures" and it is being edited by my colleague Marchetti and Tosi, and by myself. The great majority of the chapters reflect the content of a Symposium held in Formia, Italy, in June 1989, under the patronage of, among other institutions, ISB. The topic is indeed very adequate for the first Volume of the Series. By proposing this book, ISB invites the students of biolocomotion to take a break from their everyday research activity, and review the work of our predecessors with the aim of acknowledging the continuity of the scientific thoughts, clarifying established concepts, and drawing inspiration for future work. It may also become a very useful reference book while preparing lectures. A little bit of history always draws the interest of students and it is often an effective way of introducing new concepts

Another important sign of the fact that Biomechanics is now recognized as an established discipline, is the organization of World Congresses on Biomechanics on a regular basis. As all of you know, the first one was held in San Diego, U.S.A., last September under the chairmanship of Y.C. Fung It has been a huge gathering. Over 1000 papers were presented spanning all possible aspects of Biomechanics. The Second World Congress will take place in Amsterdam in 1994, and the following probably in Japan. Associated with the organization of these congresses and by action of the same group of colleagues who started them, a World Committee for Biomechanics has been established with the aim of exploring possible means of coordination of the activities and events in Biomechanics worldwide. ISB is represented in this committee by five of its council members. This is another opportunity for our Society to give a crucial contribution to the development of Biomechanics.

Our biennial congresses, which, I would like to emphasize, are also very pleasant gatherings of friends, proceed with the one which is going to be held in Perth in December. Graeme Wood and his collaborators have done a very good job and we all are looking forward to enjoying their hospitality and very profitable scientific sessions.

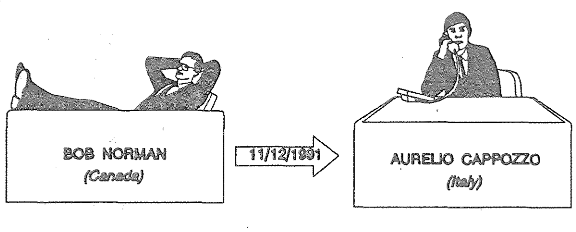
In 1993 we will be back to Europe, in Paris. Simon Bouisset will organize everything for us in a location not far from where Etienne Jules Marey produced the first cinematographic recordings of human and animal motion.

In Perth I will assume the responsibility of President of ISB. I will carry this task to the best of my capacity hoping to further contribute to the constructive role that ISB has had so far within the scientific community. I take this opportunity to thank all of you for the confidence placed on me.

I am sure that I interpret your thoughts correctly in acknowledging the excellent work that Bob Norman has carried out with great enthusiasm and dedication for our Society. We all owe him a warm thank you.

I look forward to seeing you in Perth and to working together.

Aurelio Cappozzo



Special article

ADVANCES IN THE DISCOVERY OF THE CAUSES OF PAIN

by

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In this paper, I would like to focus on the conceptions of the description and briefly outline its underlying neural pathways which were presented in the last studies described by Fields[1], Wall and Melzack[5] and group of the scientists of International Association for the Study of Pain (IASP)[4]. The definition of pain is crucial - explained Wall[5] and Casey[2]. Definitions based on the stimulus and on the outcome cannot be adequate because they must assume a fixed stimulus-response relationship. The working definition of pain of the Taxonomy Committee of the International Association for the Study of Pain is: " pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage ".

According to Fields[1], ninety percent of patients with persistent pain fall into four categories, namely those with (i) deep tissue damage such as arthritis and cancer, or (ii) peripheral nerve damage such as amputation, or (iii) root damage such as arachnoiditis, or (iv) pain with no objective pathology and no adequate explanation, for example, most low back pain and headaches.

Fields presents[1] an original systematic conception of pain. In most cases the sensation of pain is produced either by injury or by stimuli that are intense enough to be potentially injurious. Along with the subjective experience of pain, noxious stimuli elicit a variety of behaviours that all serve to protect uninjured tissues. Under different circumstances, tissues can be protected either by withdrawal reflexes, escape, immobilization of the injured part, or by avoiding future encounters with similar damaging stimuli.

Between the stimulus of tissues injury and the subjective experience of pain is a series of complex electrical and chemical events. There are four distinct processes involved, viz: transduction, transmission, modulation, and perception. Embedded in the various tissues are nerve endings that respond best to noxious stimuli. Transduction is the process by which noxious stimuli lead to electrical activity in the appropriate sensory nerve endings.

The second process, transmission, refers to the neural events subsequent to transduction. Once the noxious stimulus has been coded by the impulses in the peripheral nerve, the sensations that result are determined by the neurons of the pain transmission system. There are three major neural components of the pain transmission system, viz: the peripheral sensory nerves, which transmit impulses from the site of transduction to their terminals in the spinal cord; a network of relay neurons that ascend from the spinal cord to brainstem and thalamus; and reciprocal connections between thalamus and cortex.

Modulation, the third process, refers to the neural activity leading to the control of pain transmission neurons. A distinct pathway has been discovered in the central nervous system that selectively inhibits pain transmission cells at the level of the spinal cord. When the pain modulation system is active, noxious stimuli produce less activity in the pain transmission pathway. The activity of this modulatory system is one reason why people with apparently severe injuries may deny significant levels of pain.

The final "process" is perception. The neural activity of the pain transmission neurons produces a subjective correlate. How this comes about is totally obscure, and it is not even clear in which brain structures the activity occurs that produces the perceptual event. Even if this problem were solvable, many questions would remain, the most immediate being whether it is possible to explain how objectively observable neural events produce subjective experience. Unfortunately, since pain is fundamentally a subjective experience, there are inherent limitations to the understanding of it.

Wall explains that science has only just begun a serious investigation of the mechanism of pain[5]. The recognition of a gate control with its components of peripheral inhibition produced transcutaneous electrical nerve stimulation; its local inhibitory circuitry produced intrathecal and epidural morphine; its descending control produced brain stimulation. It is now apparent that the gate control mechanism may explain the very rapid shifts of excitability but we must now face at least two slower processes triggered by tissue damage. These other new mechanisms involve the transport of chemicals within the axons of nerve fibres. The identification of these chemicals and their transport mechanisms offers a fundamental opportunity to propose genuinely new therapies. They are not derived from any existing treatment and which manipulate the newly recognized plasticity of the adult nervous system.

The cause of the local or referred joint pain has often been attributed to subluxation or partial dislocation. Numerous papers have been devoted to the hypothesis that slight subluxations correlate with local or referred pain[3,4]. Another problem is a fundamental lack of knowledge about the mechanisms of chronic pain[1]. Most chronic pains are perceived as arising from the musculoskeletal system. Although our knowledge of the mechanisms of pain from muscle, joint, and connective tissue has advanced greatly in the past decade, it is still far from complete. Pain is more than a sensation. The close association of the pain sensory system with the function of protection of the body from damage is unique among the sensory systems[1].

Clinically, the most important distinction to make is between pain detection threshold and pain tolerance. Detection threshold is a property of the sensory system that depends on the type of stimulus used. Pain detection threshold is highly reproducible in different individuals and in the same individual at different times. In contrast to this reproducibility of pain threshold, pain tolerance is highly variable[1]. Keeping this difference between the pain threshold and pain tolerance in mind is a major key to understanding the variability of pain. Pain tolerance is a manifestation of a person's reaction to pain and it is highly dependent on psychological variables. Even when our knowledge of the physiology and chemistry of pain transduction, transmission, and modulation is much more advanced, we will still be far from our goal of adequate treatment for all chronic pain patients. In treating pain, it is fully justified to use a combination of therapies which push and pull the system toward normality. Now that we are learning to accept that pain is not the simple activation of a single specific, isolated signalling system but is subject to a series of controls acting in the context of a whole integrated nervous system, it becomes relevant and necessary to utilise combined forces to allow the system to move into a painfree mode of operation[1].

References

1. Fields H.L.: Pain, McGraw-Hill, Inc., 1987.
2. Casey K.L., Dubner R.: Animal models of chronic pain: scientific and ethical issues, Pain, 38: 249-252, 1989.
3. Mills K.R., Newham D.J., Edwards R.H.T.: Muscle pain. In: P.D. Wall and R. Melzack, (eds.): Textbook of Pain, Chapter 29, Churchil Livingstone, Edinburgh, 1989.
4. International Association for the Study of Pain, Refresher Courses on Pain Management, Syllabus, April 1, Adelaide, Australia, 1990.
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Laboratory feature

Biomechanics Laboratory, Department of Exercise Science, University of Massachusetts Amherst, MA 01003, USA

The Department of Exercise Science was the first department in the United States to depart from the traditional Physical Education curriculum to create a department solely studying the science of exercise. The Department of Exercise Science provides a multi-disciplinary home with research specialities in five laboratories. These laboratories relate to the disciplines of Biomechanics, Exercise Biochemistry, Exercise Physiology, Motor Integration, and Biofeedback. Presently there are 8 faculty members, 35 graduate students (11 doctoral), and 275 undergraduates in the department.

Undergraduate and graduate programs are offered resulting in BS, MS, or PhD degrees. The undergraduate program emphasizes a science curriculum which includes physics, calculus, chemistry, biology, and computer science pre-requisites before entering the program. The graduate program requirements emphasize a strong science background. The program encourages the student to develop a multi-disciplinary approach to problems. In addition, prospective students in Biomechanics should have a strong math/computer science background.

Two faculty members, Dr. Joe Hamill and Dr. Robert Andres teach classes in Biomechanics and Ergonomics. In addition, Dr. Ken Holt, a faculty member in the Department of Physical Therapy at Boston University, is a regular member of the research team in the lab. The laboratory has an excellent working arrangement with other faculties in the university community such as those in the mechanical engineering, electrical engineering, industrial engineering and experimental psychology departments. In addition, Dr. Hamill is an adjunct faculty in the Department of Medicine at the Medical School. Currently, the Biomechanics Laboratory has 4 PhD and 8 MS degree students working in the area of Biomechanics and Ergonomics.

Laboratory Facilities

The Biomechanics Laboratory is located in the basement (where else) of a building in the north-east corner of campus. The facility was formerly used as an archery range. At last count, this makes two labs that were formerly used as such (UMass and Penn State). The facility is 120 feet long and 40 feet wide with a 14 foot ceiling. In the majority of cases all data collection sessions are conducted in the lab. The following equipment is available in the lab:

Computers
3 SUN mini-computers
10 IBM compatible 386 computers
5 Macintosh computers
2 Laser printers
4 line printers
Ethernet system

High Speed Video
2 NAC 200 Hz cameras
2 200 Hz recorders
4 Motion Analysis 60 Hz cameras
4 Panasonic 3400 recorders
Motion Analysis VP110 video processor

Force Measurement
2 A.M.T.I. force platforms (1 imbedded in a 90 foot runway and 1 moveable)
1 pressure sensitive mat (Tekscan, Inc.)
1 in shoe pressure system (Tekscan, Inc.)

Treadmill
1 motorized treadmill

EMG
8-channel Therapeutics, Inc. amplifier
pre-amplified electrodes

Specialized Equipment
1 Exeter Research Impact Tester
1 Exeter Research Shoe Flex tester

All equipment is computer interfaced via analog-to-digital converters. The computer software used in the lab has been written by the faculty and students, both current and former, working in the lab.

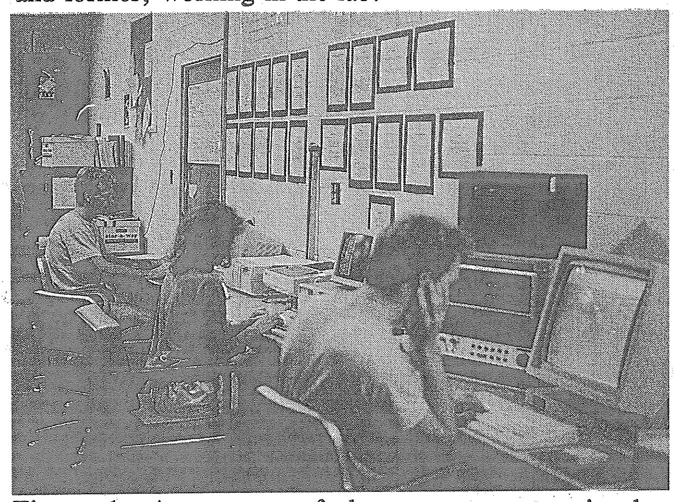

Figure 1: A segment of the computer area in the Biomechanics Laboratory. The students are (left to right): Bob Hintermeister, Teri Goodman, Michael Slavin. Michael is working on the Motion Analysis Video Processor.

Research Interests

Research in the Biomechanics Laboratory is currently funded by the U.S. Army, U.S. Diving, and several industrial clients. The focus of all of this work has been the mechanics of lower extremity function. This general area includes normal and pathological gait, walking, running, and landings from jumps. Since the department encourages interdisciplinary research, the majority of studies conducted in the laboratory have a physiological, biochemical, or motor control component. Research studies have been conducted in conjunction with Drs. Freedson (Exercise Physiology), Clarkson (Exercise Biochemistry), and Kroll (Motor Integration). Presently, studies are being conducted in a number of these areas.

Dr. Hamill and Dr. Holt, in conjunction with Dr. Barry Bates from the University of Oregon, have just completed a study on the timing of lower extremity joint actions. The purpose of this study was to describe the timing relationship between the actions of the sub-talar and knee joints during the support phase of the running stride. A disruption in the timing of these two joints has been suggested as a possible mechanism for "runner's knee". A new study using the same protocol is presently underway focusing on runners with a forefoot varus problem.

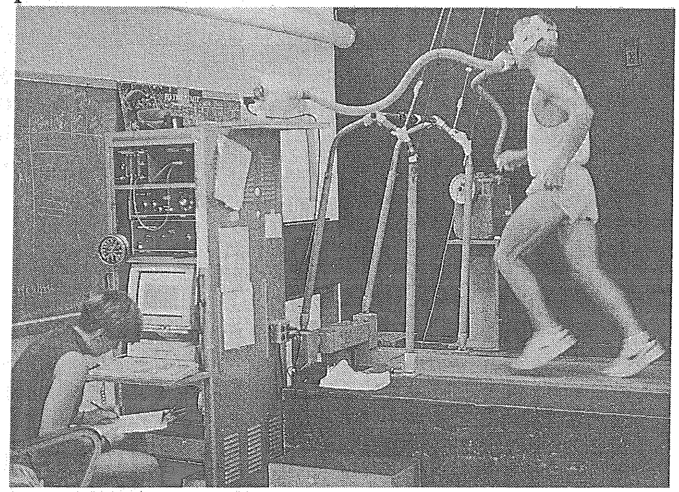

Figure 2: Jill Crussemeyer collecting metabolic data for a running economy study.

A recent PhD graduate, Wanda Boda, received a grant from US Diving to study the oscillations of the diver/springboard system. The results of this study were used to determine the optimal fulcrum setting for each diver. Dr. Boda is currently on an NIH post-doctoral appointment at the Kessler Rehabilitation Institute in New Jersey.

Michael Slavin, a Master's degree candidate who will be attending the University of California-Davis in the fall of 1991, is studying the efficiency of heel-toe and forefoot strike footfall pattern runners. He is using subjects who may be classified as either heel-toe or forefoot strikers in the study. The results indicate that runners are more efficient using a heel-toe pattern even if their preferred footfall pattern is as a forefoot striker.

A PhD candidate, Bob Hintermeister is studying the relationship between mechanical and metabolic work measures across running speeds. Using highly trained

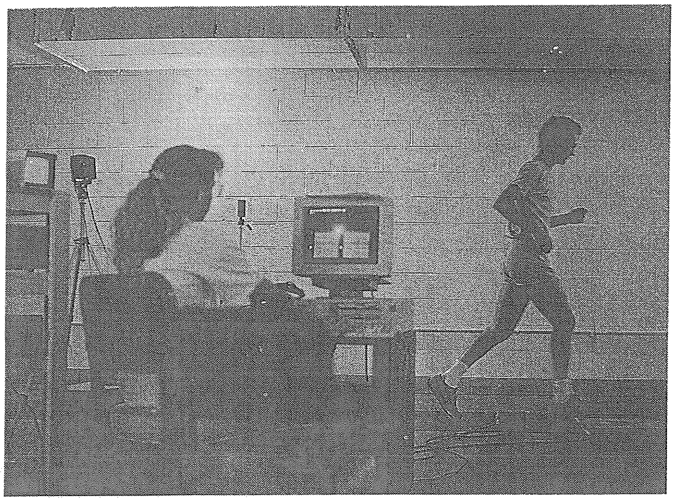

Figure 3: PhD student Theresa Foti collecting force platform data on a study on rearfoot loading.

runners, he is correlating metabolic work with several different algorithms of computing mechanical work. One particularly interesting area of study that is being conducted by Dr. Ken Holt and Dr. Hamill is modelling human locomotion as a force driven harmonic oscillator. Drs. Holt, Hamill, and Andres have published 2 papers so far on this topic. Drs. Holt and Hamill have proceeded further on this topic using a non-linear dynamics approach. Dr. Holt is also using this approach to differentiate between healthy and injured clients in a clinical setting. Holt and Hamill are also using the oscillator model to "tune" non-skilled runners to their preferred frequency.

Visitors Welcome

Anyone who is interested in visiting the laboratory should contact:

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USA

Recent Publications

1. Hamill, J. et al. Relationship of static and dynamic measures of the lower extremity. *Clin. Biomech.* 4(4), 217-225, 1989
2. Greer, N.L. et al. Dynamics of children's gait. *Human Movement Sciences* 8, 465-480, 1989
3. Boda, W.L. and Hamill, J. Analysis of the initiation of backward rotations in diving. *1st IOC Conference Proceedings,* 326-327, 1989
4. Hamill, J. et al. Arch index and kinematic lower extremity measures. *XIIth ISB Conference Proceedings*, 396, 1989
5. Holt, K.G. et al. The force driven harmonic oscillator as a model for human locomotion. *Human Movement Sciences* 9, 55-68, 1990
6. Hamill, J. and McNiven, S.L. Reliability of ground reaction force parameters during walking. *Human Movement Sciences* 9, 117-131, 1990
7. Holt, K.G. et al. Running at resonance: is it a learned phenomemon? *VIth CSB Proceedings*, 115-116, 1990
8. Holt, K.G. et al. Predicting the minimal cost of human walking. *Med. Sci. Sports Exer.* 23(4), 491-498, 1991
9. Hamill, J. et al. Muscle soreness during running: biomechanical and physiological implications. *Inter. J. of Biomech.* 7(2), 125-137, 1991
10. Widrick, J. et al. Effect of internal work on the calculation of optimal pedalling rates. *Med. Sci. Sports Exer.* (in press), 1991

ISB CONGRESS PROCEEDINGS AVAILABLE

The Proceedings from the XIIth International Congress of Biomechanics held at UCLA in June, 1989 in Los Angeles, California USA are now available. The 850-page volume contains two-page abstracts of 413 free communications (oral and poster sessions) presented at the ISB Congress. Since the two-volume hardbound series will not be published as for previous ISB Congresses, these proceedings are an important literature source.

The cost of the Proceedings is as follows:

$30.00 (U.S.) for ISB members
$40.00 (U.S.) for non members

plus postage and handling:

$2.50 (U.S.) for US and Canada
$10.00 (U.S.) for all other countries

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Thesis abstract corner

Single Muscle Contractions Can Produce Muscle-Tendon Injury

by

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Degree: Master of Arts

Supervisor: James G. Hay, Ph.D.

Garrett et al. modeled muscle injury by lengthening both active and passive muscle-tendon units until they suffered complete functional and structural failure at the distal muscle-tendon junction. McCulley et al. modeled muscle injury by subjecting the muscle-tendon unit to 450 slow eccentric contractions maintained within the maximum physiological length of the unit. This protocol caused functional and structural losses on a much smaller scale than those produced by the Garrett et al model and probably simulated the muscle damage associated with the delayed onset of muscle soreness. Neither concentric nor isometric protocols caused functional or structural losses. McCulley et al. established that muscle injury can be reproduced by slow eccentric contractions even if the contractions are restricted to physiological length limits. However, it was not established that muscle injury can result from a single eccentric contraction maintained within the physiological length limit.

The purpose of this study was to examine the effect of a single contraction on the incidence and severity of muscle-tendon injury in a rat model. The contraction was maintained within physiological limits of length and velocity. Injury was defined as a statistically significant reduction in the isometric force production of the muscle-tendon unit. It was hypothesized that: (1) injury could occur as a result of a single eccentric contraction maintained within physiological length and velocity limits; (2) as the velocity of the eccentric contraction increases, the severity of injury increases; and (3) units that contract concentrically immediately after contracting eccentrically will be more severely injured than units that contract eccentrically only.

Thirty male Sprague Dawley rats were separated into three groups of ten. The tibialis anterior (TA) of one limb was subjected to an experimental protocol and the contralateral TA served as a control. The initial length of the TA fibers was set at 90% of the maximum length of the TA fibers (Lfmax) and the sciatic nerve was stimulated to produce a pre-test maximal contraction of the TA. Two minutes later the experimental TAs were subjected to one of three test eccentric contractions:

Group 1 - slow eccentric (1 Lfmax/s)
Group 2 - fast eccentric (10 Lfmax/s)
Group 3 - fast eccentric followed by fast concentric (10 Lfmax/s)

A 2 x 3 (Test type x Group) ANOVA and a Tukey's post-hoc analysis were used to test for significant differences in the reduction of isometric force production.

The results suggested that a fast eccentric contraction and a fast eccentric contraction followed by a fast concentric contraction more frequently produce injury than a slow eccentric contraction. These results support the first and second hypotheses, but not the third.

The Relationship Between Body Roll and Handpath During the Pull Phase in Freestyle Swimming

by

Qi Liu

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Degree: Master of Arts

Supervisor: James G. Hay

In the last twenty years, researchers studying the biomechanics of swimming developed a theory of propulsion that caused a major re-evaluation of old concepts. This theory emphasizes the role played by lift forces in the generation of hand propulsion.

Hay, Liu, and Andrews (1989) suggested that the path followed by a swimmer's hand might be attributed to motion of the arm relative to the trunk, to rolling of the trunk about the longitudinal axis, or to a combination of these two, and performed a computer simulation to explore these possibilities. There appear, however, to have been no attempts to quantify the influence of body roll on handpath in actual freestyle swimming. The purpose of this study was to determine the influence of (a) body roll and (b) arm motion relative to the trunk, on the path followed by the hand during the pull phase in freestyle swimming.

Ten members of the men's swim team at the University of Iowa served as subjects. Each subject

performed two 15 meter freestyle swims at their long distance workout pace. Two video recording systems recorded each performance from front, side, and bottom views. For each subject, body roll angles and coordinates of the right-hand fingertip were analyzed.

Descriptive statistics of the body roll angle versus time and of the maximal body roll angles were obtained. Normalized x and y coordinates of the fingertip versus time were determined and plotted. Descriptive statistics were obtained for the angular speed of body roll and the normalized fingertip speed in the forward-backward and medial-lateral directions versus time. Methods for geometric analysis of the influence of body roll on handpath were developed and applied.

The mean value of maximal body roll angle for all subjects was 61 degrees. The greatest angular speed of body roll occurred during the beginning and end of the pull phase, and the smallest occurred near the middle of the pull phase. The right fingertip was accelerated backward relative to the shoulder during the first 60 percent of the pull phase, then maintained a near-constant velocity until the end of the pull phase. The fingertip was accelerated medially during the first 30 percent of the pull phase, and laterally between 60 and 80 percent of the pull phase. The medial-lateral motions evident in the actual handpath were due approximately equally to body roll and upper limb relative motion.

Regulation of Stride Length During the Last Four Strides of the Long Jump Approach

by

Nikki S. Robinson

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The University of Iowa, Iowa City, IA 52242
Degree: Master of Arts

Supervisor: James G. Hay, Ph.D.

Lee, Lishman, and Thomson (1982) conducted a landmark study on the role of accuracy in the long jump approach. By examining the relationship between gait parameters and stride length, they concluded that vertical impulse is the sole kinetic mechanism used to control stride length during the run-up.

The purpose of the present study was to test the hypothesis that vertical impulse is the single kinetic parameter used to regulate stride length during the last four strides of the approach in the long jump.

Two sets of kinematic gait parameters were measured for each of the last four strides in 275 filmed trials by 14 elite male and female long jumpers. One set of gait parameters was identical to that identified by Lee et al. as determining a stride length. They were thrust distance, landing distance, flight time, and flight speed. The second set consisted of modified and extended parameters, (a) paralleling the set selected by Lee et al., and (b) necessary to calculate the vertical impulse of the subjects' strides. They were takeoff distance, touchdown distance, flight time, horizontal velocities of takeoff and touchdown, relative height of takeoff, and support time.

The vertical impulse values were calculated, and the relationship of vertical impulse with stride length was formally tested. The data were re-examined to determine (a) what accounted for the difference in results between Lee et al. and the current study, and (b) what were the true determinants of variation in stride length.

Two approaches were used to identify the determinants of the changes in the subjects' stride lengths. The first, a modelling approach, used a deterministic model of stride length to identify significant relationships between gait parameters and stride length. The second a multiple regression approach, used a stepwise regression to identify the best possible set of gait parameters to predict the changes in stride length.

The single most important finding of the study was that vertical impulse is not the single kinetic parameter used to regulate stride length over the last four strides of the long jump approach. The discrepancy between this conclusion and that of the Lee et al. study was due to limitations in the theory of the Lee et al. study. An attempt to find a small subset of gait parameters that accounted for the majority of the variance in stride length was unsuccessful. It appears that many small contributions by a large number of gait parameters determine the changes in stride length made by an athlete during the final strides of the approach.

EDITOR'S NOTE

Thesis abstracts should be submitted with full details of:

Title, Student's Name, Department, Name of Degree and Conferring Institution, together with Supervisor's Name.

Abstracts should not be more than one Newsletter page in length, and any complex equations or graphics must be in good quality black and white form for ease of reproduction. The text of the abstract can be submitted either as letter-quality print which is computer scannable or as a text-only file on diskette.

Hand Pressures as Predictors of Resultant and Propulsive Hand Forces in Swimming

by

Anne M. Thayer

Biomechanics Laboratory
Department of Exercise Science
The University of Iowa, Iowa City, IA 52242
Degree: Doctor of Philosophy

Supervisor: James G. Hay, Ph.D.

The purpose of this study was to determine the extent to which the resultant and propulsive forces acting on the hand of a swimmer can be satisfactorily predicted from measures of local pressure on the hand.

Two full-scale moulded acrylic hand models were instrumented with 127 pressure taps. Tests were conducted in a recirculating water flume. The hand model was mechanically moved through the water. Motions simulating the freestyle stroke and the propulsive phase of the breaststroke pull were each tested in two orientations, yielding four test conditions. Strain gages fixed to the shaft supporting the hand model were used to measure the forces on the hand. The forces and pressures were recorded throughout the range of motion of the hand through the water.

Under each of the four conditions, the pressure measured at a single pressure tap was termed a good predictor if it was able to predict the resultant force (and the propulsive force) with an R^2 value of 0.85 or greater. The locations on the hand of these good predictors were shown to vary with the stroke being simulated and the relative orientation of the hand to the flow. No single pressure tap was able to predict the resultant (or propulsive) forces with acceptable accuracy under all conditions of motion and orientation.

Using an all-possible-regressions procedure, four sets of two taps which could predict the resultant force for all four conditions, and three sets of three taps which could predict the propulsive force for all four conditions were identified. However, no single equation that could predict the resultant (or propulsive) force could be found.

When the data sets for all four conditions were combined and the all-possible-regressions procedure used, the results showed that a minimum of eight taps was needed to predict the resultant force, and a minimum of eleven taps was needed to predict the propulsive force with acceptable accuracy.

Due to changing conditions of hand motion and orientation during the stroke, the prediction of the resultant and propulsive forces on a swimmer's hand cannot be satisfactorily obtained with a small number of pressure measures on the hand.

Optimization of the Valgus Intertrochanteric Osteotomy

by

John A. Miller, Jr.

Biomechanics Laboratory
Department of Exercise Science
The University of Iowa, Iowa City, IA 52242

Degree: Doctor of Philosophy

Co-Supervisors: Professor James G. Andrews
Professor Richard A. Brand

The purposes of this investigation were (1) to define the looseness of the hip in a clinically relevant way, (2) to develop an algorithm that calculates the looseness of the hip over the range of hip configurations encountered during normal activities of daily living, and (3) to identify the intertrochanteric osteotomy in a given case of osteoarthritis that minimizes the looseness of the hip.

Three potentially useful looseness indices were defined -- the characteristic point locus, the joint space, and the contact region. Logistic regression was used to analyze selected data for 38 subjects who received valgus osteotomies. The final logistic regression equation for each of three definitions of osteotomy outcome (success/failure) was used to predict the probability of success associated with a specific osteotomy. The osteotomy with the largest probability of success identified the predicted optimal osteotomy for each outcome. For each final logistic regression equation, the degree of fit was low (R=0.270; R=0.303; R=0.354), while the number of correctly predicted outcomes was moderate (78.9%; 68.4%; 78.9%).

The joint space looseness index appeared to be the most useful of the three looseness indices because it (1) exhibited a dominant, unimodal variation with osteotomy angle which would facilitate the prediction of an optimal osteotomy, and (2) remained as the only independent variable (albeit in different forms) in two of the three final logistic regression equations.

Considerable agreement (71.1 percent) was found between the clinical indication of a valgus operation, and the prediction of a valgus optimal osteotomy for the logistic regression equation associated with Outcome 1: Pain. This result is of importance because relief from the pain created by the changes in the joint from osteoarthritis is the primary concern of the patient considering surgical treatment. Thus, the logistic regression equation for Outcome 1 may potentially be useful to the surgeon in generating supplemental information which could be used to verify a clinical indication or to select an optimal osteotomy.

Conference news

NACOB II: The Second North American Congress on Biomechanics

The Congress combines The Sixteenth Annual Conference of the American Society of Biomechanics (ASB) and the Seventh Biennial Conference of the Canadian Society for Biomecchanics/Societe Canadienne de Biomechanique (CSB/SCB).

Locomotion VII, the symposium of the CSB, will this year concentrate on the interface between research and clinical practice found in gait and posture laboratories, and carries the thought provoking title of "Clinical Gait and Posture Laboratories: Information or just Data?". This topic will be addressed by five different workers in the field who will each present position papers, following which a panel discussion chaired by Dr David Winter will take place.

The ASB has chosen "Space Biomechanics: The Biomechanics of the Weightless State" as their symposium topic. Issues discussed will include the effect of weightlessness on the musculoskeletal system, the cardiovascular system, and the vestibular system.

Dates and Venue:

August 24-28, 1992
Chicago, Illinois - McCormick Center Hotel,
Deadline for receipt of Abstracts: April 3, 1992.

All correspondence should be addressed to:

Louis F. Draganich, PhD
University of Chicago
Section of Orthopaedic Surgery & Rehabilitation Medicine
5841 S.Maryland Ave - Box #421
Chicago, IL 60637

Tel: (312) 702-6839 Fax: (312) 702-0076

European Symposium on Clinical Gait Analysis Federal Institute of Technology, Zurich, Switzerland April 1-3, 1992

Scientific Committee:

J.U. Baumann, Switzerland
U. Boenick, Germany
A. Cappozzo, Italy
H. Lanshammar, Sweden
J.P. Paul, Scotland
E. Sern, Germany
E. Stuessi, Switzerland

Topics:

Session 1: Prosthetics/Orthetics
Session 2: Therapy/Rehabilitation
Session 3: Neurology/Neuro-Orthopaedics

Invited papers:

U. Boenick (Berlin), Optimization of prosthetic supply
A. Cappozzo (Rome), Gait analysis with low back pain patients
R. Gregor (Los Angeles), Interaction between motion analysis lab and therapy
H. Lanshammar (Uppsala), Repeatability and validity of human gait data
K.-H. Mauritz (Berlin), Rating of gait analysis in neurologic rehabilitation
J.P. Paul (Glasgow), Quantifying human gait: development and state of the art
E. Senn (Munich), Rank of gait analysis in physical therapy
S.R. Simon (Columbus), Clinical gait analysis: state of the art, perspectives
D. Sutherland (San Diego), Development of mature gait

Organiser:

Laboratory for Biomechanics, Federal Institute of Technology
Secretariate Gait Analysis Symposium
Wagistrasse 4, CH-8952 SCHLIEREN, Switzerland

Tel: +41(1)731 0785; +41(1)733 6214 (after 1 Nov 1991)
Fax +44(1)731 0789
Email: BIOMECHA@CZHETH5A.BITNET (Prof.Stuessi)

Dates:

1 Nov 1991 -	Deadline for abstracts (10 lines)
1 Jan 1992 -	Notice of acceptance of papers
1 Mar 1992 -	Deadline for registration and papers (4 pages.)

Social Program:

31 Mar 1992	Welcome drinks and registration
1 Apr 1992	Visit at the Biomechanics Laboratory of ETH Zurich
2 Apr 1992	Common dinner at ETH Zuerich
3 Apr 1992	Visit at Kistler Instruments SA in Wintherthur

NATO Advanced Research Workshop
ADVANCES IN THE BIOMECHANICS OF THE HAND AND WRIST

To be held at Brussels, Belgium, from 22-23 May, 1992.

The main objective of this workshop is to promote the interchange of ideas and collaborative investigation among clinicians and basic scientists. Specific aims are:

1. To summarize current scientific knowledge in the area of hand and wrist biomechanics,
2. To identify related clinical problems and potential solutions based on current scientific knowledge,
3. To establish direction for future investigation.

The workshop sessions will be arranged based on the anatomic structures of the hand and wrist. In each session, the state-of-the-art research methods and results will be reported first, followed by discussion of currently unsolved clinical problems, possible applications of scientific findings, and solutions.

The workshop participants will include basic scientists and clinicians. The Faculty will include 23 experts, invited as key speakers to present reviews and lecture on specific topics. Additional participants are encouraged to join the open discussion, and may submit original papers that will be accepted in limited number for presentation.

Topics

* Biomechanics of tendon: structure and mechanical properties; techniques of repair; rehabilitation and principles of mobilization.
* Biomechanics of ligaments: structure and mechanical properties; functions related to joint motion and stability; injury and repair.
* Biomechanics of bone: mechanical properties; morphometry and geometry; fracture fixation.
* Biomechanics of joint: geometric analysis; kinematics; force analysis; injury; arthroplasty.
* Function: muscle physiology; integrated functions; tendon transfers; functional evaluation.
* Ergonomic considerations: grip function; pathomechanics of work related disorders; biomechanics of work design.

Call for Papers:

Dec. 15, 1991 - Deadline for submission of abstracts.

Jan. 15, 1992 - Notification of acceptance.

Apr. 30, 1992 - Deadline for reception of manuscripts for publication in the NATO book.

For details and registration information, contact:

Dr F. SCHUIND
Department of Orthopaedic Surgery
Erasme University Hospital
Route de Lennik 808, B-1070 Brussels, BELGIUM
Tel: 32/2/555 36 91 Fax: 32/2/520 35 56

Announcements

Positions Available

Assistant Professor in Locomotion Studies/Biomechanics

The Center for Locomotion Studies at Penn State University seeks qualified candidates for an Assistant Professor position in the Biobehavioral Health Program. Responsibilities include: teaching at the graduate and possibly undergraduate levels, advising masters and doctoral students, generating external grant support, participating in interdisciplinary research projects, and possible committee assignments. Successful applicants should hold a Ph.D. in an appropriate field and should plan to conduct research and teaching in an area directly related to the study of human gait and lower extremity biomechanics. Screening of applications will begin immediately and the search will continue until a suitable candidate is found.

Applications:

To receive full consideration, applications must be received by December 13, 1991. Please submit vita and names and addresses of three references to:

Peter R. Cavanagh, Ph.D., Chair, Search Committee, Center for Locomotion Studies, Intramural Building, Penn State University, University Park, PA 16802.

AA/EOE. Women and minorities are encouraged to apply.

Senior Lecturer/Lecturer in Biomechanics Victoria University of Technology, Australia

Qualifications Postgraduate qualifications (Phd preferred) in Biomechanics or closely related subject. Experience Looking to employ person with expertise in area of Sport Biomechanics (essential) and/or Gait Analysis (advantageous). Background knowledge in Neurobiomechanics helpful but not essential. Opportunities Develop the department's and your own research interests. Teaching and supervising undergraduates/ postgraduates in sport biomechanics, rehabilitation biomechanics and gait. Contract 3 years. Victoria University of Tech. is an equal opportunity university.

Please send initial enquiries to:

Russell J. Best, Biomechanics Unit
Department of P.E. and Recreation
Victoria University of Technology
Ballarat Road, Footscray 3011
AUSTRALIA

Fax: Aust. (03) 688 4891 Tel: Aust. (03) 688 4432

Faculty Positions in Biomedical Engineering Tulane University, USA

Two positions are expected to be available beginning Fall, 1992. Both are tenure-track full-time appointments in the School of Engineering, with rank and salary based upon the candidate's qualifications. The positions are:

(1) a specialist in polymeric biomaterials and biomedical materials science, and
(2) a specialist in instrumentation or medical imaging or biomedical signal processing.

Applicants must have an earned doctorate, and will be expected to initiate new undergraduate and graduate courses and to develop an externally funded research program with publishable results. Send CV and names of references by February 15, 1992 to:

Dr. Cedric Walker
Dep't. of Biomedical Engineering
Tulane University
New Orleans LA 70118, USA

Tulane University is an Equal Opportunity / Affirmative Action employer.

Program Development Director

Description:

The Program Development Director for the American Coaching Effectiveness Program (ACEP) is a full-time, permanent position. The responsibilities of this position include developing and revising materials for ACEP's curriculum, conceptualizing and organizing the content for courses and resources, planning specific publications, writing and editing manuscripts, working with authors, communicating with staff and outside agencies and individuals.

Qualifications:

1. College education or advanced degree
2. Sports background and sports science knowledge
3. Commitment to sport and coaching education
4. Excellent writing skills and good editorial skills
5. Attention to accuracy in work of self and others
6. Excellent conceptual and analytical skills
7. Excellent planning and organizational skills
8. Experience and interest in designing instructional programs
9. Ability to work independently on long term projects

Salary: Commensurate with experience, plus benefits.

Apply to: Human Resources Manager, ACEP
Box 5076 Champaign, IL 61825-5076
USA

Calendar of scientific events

February 2-7, 1992
International Scientific Congress associated with the 1992 Winter Olympic Games and devoted to sport sciences related to mountain sports. Enquiries to: CERNA, B.P. 35, 73202 Albertville Cedex, France.

May 7-8, 1992
International Biomechanics Seminar, Centre for Biomechanics, Göteborg, Sweden. Contact: Gunilla Ekman, Centre for Biomechanics, Chalmers University of Technology, S-412 96 Göteborg, Sweden. Tel: +46-31-721515; Fax: +46-31-721192.

May 18-19, 1992
European Conference on Joint Replacement in the 1990's, East Midlands Conference Centre, Nottingham, UK. Contact: Ms Alison Elgar, Conference Department C441, Institution of Mechanical Engineers, 1 Birdcage Walk, London SW1H 9JJ. Tel: (071) 973-1281; Fax: (071) 222-9881.

May 12-14, 1992
International Scientific Conference on Prevention of Work-Related Musculoskeletal Disorders, Stockholm, Sweden. Conference Secretariat: Ms Gun Carlsson, National Institute of Occupational Health, S-17184 Solna, Sweden. Tel: +46-8-730-9100: Fax: +46-8-730-1967.

May 23-27, 1992
XIth International Symposium on Posture and Gait: Control Mechanisms, Yvonne Miller-Ross, Good Samaritan Hospital and Medical Center, 1015 N.W. 22nd Avenue, N300 Portland, OR 97210 USA, Tel: (503) 229-7348; Fax: (503) 790-1201.

June 2-6, 1992
International Conference on Computer Applications in Sport and Pysical Education, Wingate Institute, Israel. Conference Secretariat: Int. Conf. on Com. Appl. in Sport and Pys. Ed., Wingate Institute, Netanya 42902, Israel. Tel: 972-53-29548; Fax: 972-53-54374.

June 7-10, 1992
Canadian Medical and Biological Engineering Society (CMBEC), CMBEC Secretariat, Room 305, Building M-50, National Research Council of Canada, Montreal Rd., Ontario, Canada K1A 0RO.

June 10-14, 1992
Annual International Industrial Ergonomics and Safety Conference '92, Denver, Colorado, USA. Contact: Dr S. Kumar, Conference Chair, Dept. of Phys. Therapy, University of Alberta, Edmonton, Alberta, T6G 2O4 Canada. Tel: (403) 492-5979; Fax: (403) 492-1626.

June 21-24, 1992
Eighth Meeting of the European Society of Biomechanics, in association with the European Society of Biomaterials. Conference Secretariat: ESB92, Istituto di Fisiologia Umana, Università 'La Sapienza', Piazzale Aldo Moro 5, 00185 Rome, Italy. Tel: 39-6-490673; Fax: 39-6-4452824.

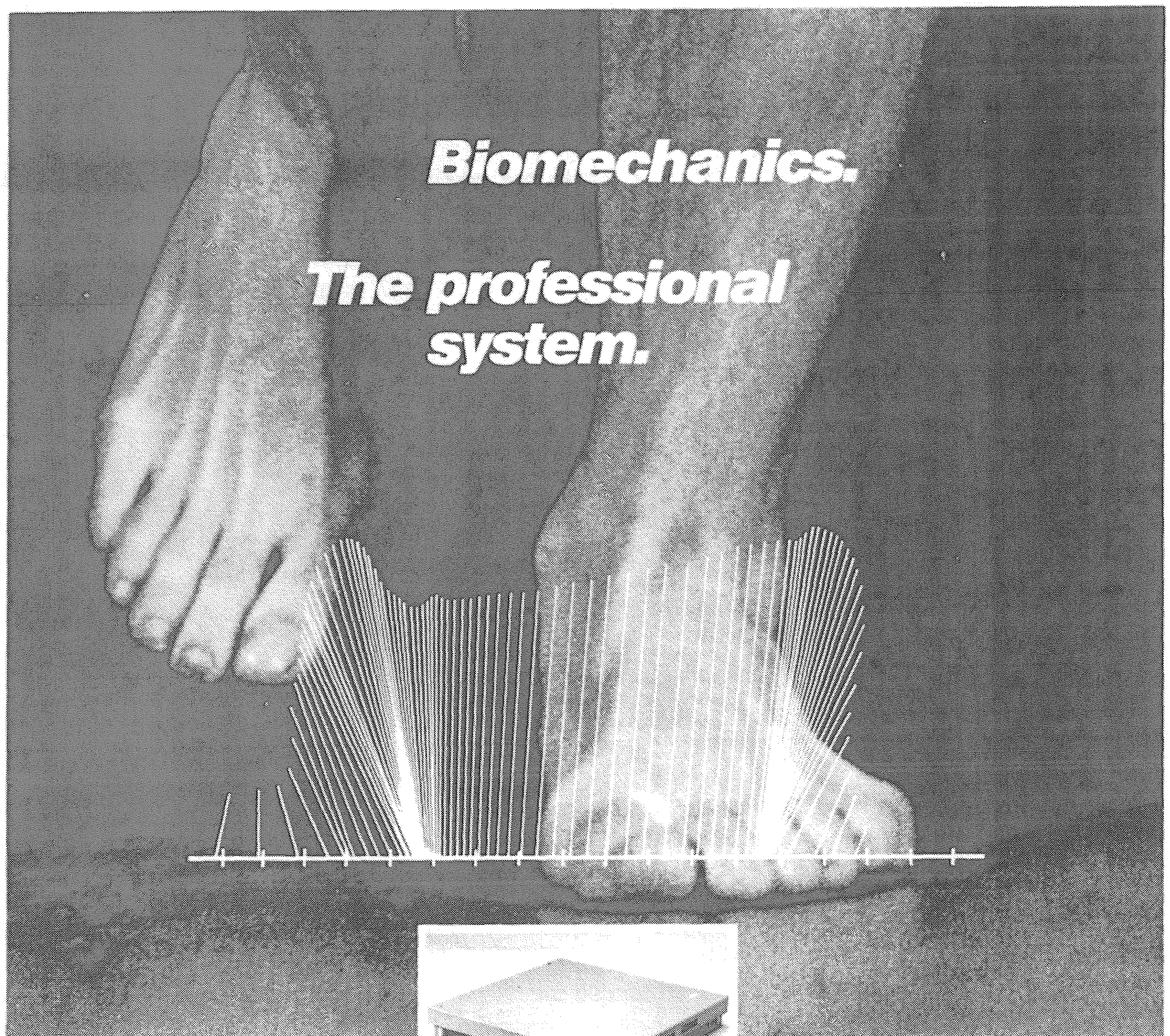
August 3-8, 1992
Eighth International Congress of Biorheology, Yokohama, Japan. Executive Secretary: Dr. Takuo Yokose, 3rd Dept. of Internal Medicine, Jikei University School of Medicine, 3-25-8 Nishi-Shinbashi, Minato-ku, Tokyo 105, Japan. Fax: +81-3-3578-9753.

August, 18-21, 1992
3rd International Symposium on Sport Surfaces, University of Calgary, Canada. Conference Office: Faculty of Continuing Education, The University of Calgary, 2500 University Drive N.W., Calgary, Alberta T2N 1N4, Canada. Tel: (403) 220-5051; Fax: (403) 289-7287.

August 24-28, 1992
Second North American Congress on Biomechanics, combining the 16th Annual Meeting of the American Society of Biomechanics (ASB) and the 7th Biennial Conference of the Canadian Society for Biomechanics/Société Canadienne de Biomèchanique (CSB/SCB), at the McCormick Center Hotel, Chicago, USA. Conference Co-Chairman: Dr Louis Draganich, Dept. of Surgery, University of Chicago, 5841 South Maryland Avenue, Box 421, Chicago, IL 60637, U.S.A. Tel: +1-312-702-6839.

September 4-5, 1992
International Conference on Experimental Mechanics: Technology Transfer Between High Tech. Engineering & Biomechanics, University of Limerick, Ireland. Conference Secretariat: BSSM'92, Dept. Mech. Eng., University of Limerick, Plassey Technological Park, Limerick, Ireland. Fax: 353-61-330316 (Ireland, Eire) or e-mail at LittleT@ul.ie

December 2-4, 1992
Seventh International Conference on Biomedical Engineering, National University of Singapore. Secretary: 7th ICBME 1992, Dept. Orthopaedic Surgery, National Hospital, Lower Kent Ridge Road, Singapore 0511. Tel: (65) 772 4424; Fax: (65) 778 0720.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