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Letter To The Editor

Dear Editor,

I have been intrigued and deeply touched by the "Poor Researcher's Fairy Tale" presented by Dr. Herman J. Woltring in the "Letter to the Editor" appearing in the ISB-Newsletter No. 25. However, a historian searching for hard facts and written proofs to investigate the substance of the claims made in that eventful tale would be utterly astonished to discover a completely different story: There was, in fact, a professor in the country of Academia who developed, in the course of his research, software which he made available to a software house for commercial distribution. In this way, other researchers and consultants could benefit by gaining rapid access to newly developed methods and algorithms.

At the same time, a particular researcher, also residing in Academia, working in the area of opto-electronic camera calibration methods, and being a commercial software producer himself, became interested in the professor's work and, even more so, in the associated software. However, he did not approach the professor for a copy, as incorrectly reported in the Fairy Tale, but contacted the software house directly under the disguise of being an employee of a reputed research institution to which he had access, illegally using their letter head for correspondence (here the historian presents written proof). This institution then acquired the program from the software house for their psycholinguistic investigations.

Now, our researcher's wish to also lay his hands on this package became so strong that a good fairy felt pity for him and, oh wonder, produced an (illegal) copy of the program. (He was at this time still permitted to enter the premises of that institution; now he no longer is).

Being greatly disturbed by the software house's copyright signature on the main program, he removed it, put his own name on instead, changed the name of the program and a number of program statements, mainly to adapt it to the computers he intended to use it on (written evidence). Apparently not being able to fully understand the algorithm, some changes he introduced were actually distracting from the capabilities of the program, let alone any idea of improvements. In fact, none of the improvements included in the updated program version originated from the researcher, as was claimed in the tale.

The researcher in our story was only seemingly an inhabitant of Academia. In reality (he tried to cover this up as much as possible) he was a citizen of the country of Commercia. As such, he approached the said software house for a joint software advertising campaign to the effect that "you recommend my software for 3-D camera calibration to your customers while I recommend your software to my customers" (here the historian again presents written documents and letters as proof). Thus, being a commercial software producer himself, the "researcher" begins distributing also the illegally copied and modified program version (written evidence is provided again) which was so mercifully supplied to him by the fairy.
The distribution took place on his own account and, of course, for purely academic reasons (?) He also implemented and used this illegal program version on a VAX11 computer at a reputed University in the same city where his programsupplying fairy resides.

The software house soon became aware of these activities and legal procedures were initiated. They ended with a compensation settlement between the software house and the institution that initially acquired the program (written proof).

Being already shattered by the facts he has unveiled, the historian finally discovers that our researcher was even more of a pharisee than he ever thought possible. Not only was the researcher, who presented himself in the country of Academia as one of last upholders of scientific tradition and opponent of the increasing commercialization of academic life, a large scale software dealer in the country of Commercia. He also sold in Commercia pre-publication copies of lectures he was invited (with payment of all expenses) to present at congresses in Academia.

By doing so, he deprived the inviting organizations of a substantial portion of their rightful income. The historian presents written proof of this and many more facts which in the present context he cannot all describe.

Is our "researcher" a commercial wolf in academic sheep skin? Since this is only a science fi(a)ctional tale, the reader may use his (her) own imagination to answer this question.

My personal view on the whole software marketing and copyright issue is this: Any scientist should have the right to make available for distribution by commercial organizations or otherwise, products of intellectual endeavour which he (she) developed during independent, non-contract research activities. This is clearly to the benefit of both parties: Other researchers gain immediate access to newly developed methods without having to invest large amounts of time and money in the development of the respective application software, while the scientists who developed the software recover part of their expenses which, in turn, enables them to proceed with the development of new methods and their computerized implementation. This system appears to function satisfactorily, as the example of the MIT - software TRACK shows. This software was developed in an academic anvironment, has been announced in various publications (e.g. Mann and Antonsson (1983) Bull. Hosp. Joint Diseases Orthop. Inst. XLIII, 137-146) and is now available commercially.

However, Copyright infringements and software piracy under the disguise of the strange postulate that "Academians have the right to copy" will always lead to legal problems, as software houses such as the IMSL or NAG will confirm.

H. Hatze
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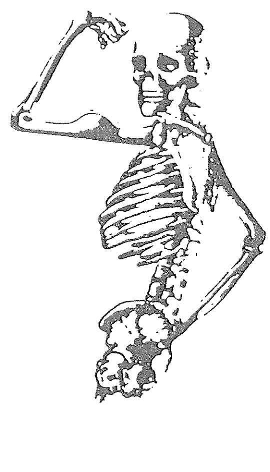
A-1150 WIEN, Austria



UNIVERSITE DE MONTREAL

DEVELOPMENT OF A METHODOLOGY FOR MEASURING THE STRENGTH OF HUMAN TENDONS IN VIVO

By

Mario Lamontagne

A tesis submitted in partial fulfillment of
the requirements for the degree of
Doctor of Philosophy in Biomedical Engineering
at the Ecole polytechnique de Montréal of
The Université de Montréal

Thesis supervisor: Dr. Roland Doré

ABSTRACT

This study represents an initial attempt in the development of a tool for the measurement of the strength of tendons in vivo. This work has been divided into three major projects: (1) the development of a special tranducer for the measurement of the elongation of human tendon for applications in vitro and in vivo; (2) the study of mechanical properties of the patellar and quadriceps tendons for different fiber sections at different angles of pull to establish the general relationships between force and elongation of these tendons; (3) the direct measurement of patellar tendon strength using the developed tendon transducer on the human patellar tendon during isometric and dynamic contractions of the leg on an isokinetic apparatus.

Different types of mercury strain gauges have been developed but only one model was used for this study. It had the best static calibration performances, its signal was conditioned with a constant circuit bridge, amplified and connected to a data acquisition system. This tendon transducer was used for the measurement of the meachnical properties of tendons in vitro and also for the measurement of the human patellar tendon strength in vivo. The mechanical behavior of patellar and quadriceps tendons was tested under normalized conditions and controlled angles of pull. The mechanical behavior of different patellar tendon sections was recorded at various angles of pull to define the ideal position of the attachment of the mercury strain gauge during the in vivo testing. The last part of this project measured the electrical potentials of the indicidual muscles of the quadriceps, the external forces and the angle variations synchronized with the patellar tendon strength for isometric and dynamic contractions on an isokinetic apparatus.

The results obtained from mercury strain gauges showed that they were linear with almost no hysteresis and accurate enough to be used as tendon transducers in this study. The results from the mechanical properties of patellar and quadriceps tendons showed that the variation of the angle of pull affected the mechanical behavior of certain fiber sections of the patellar tendon. Altough the overall mechanical behavior of the patellar tendon did not change with the variation of the angle of pull, there was a change of mechanical behavior of the quadriceps tendon. This change of mechanical behavior was very important for determining the proper location of where to fix the mercury stain gauge on the patellar tendon. The last part of the present work showed that for dynamic contractions, the tendon strength was between 3 to 4 times the external force applied at the leg extremity. The pattern of the tendon tension is similar to the pattern of the external force during this kind of contraction. Futhermore, the pattern of the tendon tension follows the electrical pattern of the quadriceps muscles. This observation allows us to affirm that the tendon transducer recorded a valid signal from the tendon. However, for isometric contractions, no signal was recorded from the tendon transducer. This can be explained by the fact that the surface fibers on which the tendon transducer was attached was not loaded during that kind of contraction.

Within the limitations of this study, we can conclude that tendon transducers can be used to measure the tension in the human tendon both in vitro and in vivo. Futhermore, this tool will allow researchers to validate or improve their mathematical articular models or electromygraphical quantitative models.

UNIVERSITY OF OREGON

Departement of Physical Education
and
Human Movement Studies

INTRADAY AND INTERDAY RELIABILITY OF GROUND REACTION FORCE DATA

Paul DeVita
(Barry T. Bates, Advisor)

Submitted in Partial Fulfillment
of the Tequirments
for the Degree of

Docter of Philosophy

August 1986

ABSTRACT

Researchers have used ground reaction force data to quantify the effects of shoes on running performance. However, few reseachers have tried to establish the reliability of the ground reaction force data over time and its effects on testing procedures. The primary purpose of the study was to investigate the reliability of selected ground reaction force parameters over several days for seven sample sizes ranging

from 3 to 50 trials. The results of the reliability evaluation were used to establish the number of trials and test days needed to produce stable mean parameter values. These later results were then used to evaluate differences between two running shoe conditions.

Six healthy male runners volunteered as subjects for each phase of the study. Following adequate practice sessions, each subject performed 50 trials on each of four days (1, 2, 8, and 9) for a total of 200 trials in order to evaluate intraday, interday and interweek reliability. The experimental setup consisted of a force platform interfaced to a laboratory computer and an infrared timing system to monitor running speed (2.29 + 5- 0.2 m/s) over a 5 m interval. Data processing consisted of the evaluation of 21 parameters for each trial. Mean trial parameter values for the different sample sizes were evaluated using an individual within subject statistical technique. Minimum detectable differences (p.05) between samples using this statistical technique range from 1.65 tot 0.40 (nonlinear) times the average standard deviation for sample sizes of 3 to 50 trials, respectively.

Statistically significant differences (p.05) were obtained for all reliability analyses. Intraday reliability ranged from 93.4 to 74.2% (6.6 to 25.8% of the comparisons were significantly different) for sample sizes of 3 to 25 trials, respectively, with decreases in the mean absolute differences between samples as sample size increased. Interday and interweek reliability results were considerably poorer and ranged from 85.3 to 44.8% and 75.3 to 35.9%, respectively, for sample sizes of 3 to 50 trials and also exhibited decreases in the mean obsolute differences. The poorer reliability for the larger sample sizes is the result of greater statistical power with increased sample size allowing for smaller differences to be detected. A sample size of 25 trials was identified as the minimum number of trials necessary to adequately describe the true population parameter values based upon the 200 trial sample data. The overall results were very similar to those obtained using a Monte Carlo computer model approach.

The results of the reliability analyses suggest that the evaluation of different running conditions be based on data obtained from within day comparisons performed on different days. Based upon this finding six subjects performed 25 trials in each of two shoe conditions on three separate days. The data analysis identified 58.8% of the observed differences as statistically significant (p. 05) but only 37.4% of the differences were greater than the mean absolute differences obtained in the reliability analyses suggesting that 21.4% of the observed differences were due to normal performer variability. Only 4 of the 48 subject-parameter combinations exhibited consistent results for all three test sessions.

The result of the study indicate the importance of adequate sample size and multiple observations if reliable and meaningful ground reaction force data are to be obtained.

ON THE BIOMECHANICS OF THE KNEE

A study of joint and muscle load with applications in ergonomics, orthopaedics and rehabilitation

by
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Supervisor: Professor Jan Ekholen
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Karolinska Institute
Stockholm

ABSTRACT

The load moment of force about the knee joint during machine milking and when lifting a 12.8 kg box was quantified using a computerized static sagittal plane body model. Surface electromyography of quadriceps and hamstrings muscles was normalized and expressed as a percentage of an isometric maximum volontary test contraction. Working with straight knees and the trunk flexed forwards induced extending knee load moments of maximum 55 Nm. Lifting the box with flexed knees gave flexing moments of 50 Nm at the beginning of the lift, irrespective of whether the burden was between or in front of the feet. During machine milking, a level difference between operator and cow of 0.70 m - 1.0 m significantly lowered the knee extending moments.

To quantify the force magnitudes acting in the tibio-femoral and patello-femoral joints, a local biomechanical model of the knee was developed using a combination of cadaver knee dissections and lateral knee radiographs of healthy subjects. The moment arm of the knee extensor was significantly shorter for women than for men, which resulted in higher knee joint forces in women if the same moment was produced. A diagram fot quantifying patellar forces was worked out. The force magnitudes given by the knee joint biomechanical model correlated well with experimentally forces measured by others.

During the parallel squat in powerlifting, the maximum flexing knee load moment was estimated to 335 - 550 Nm when carrying a 382.5 kg burden and the *in vivo* force of a complete quadriceps tendon-muscle rupture to between 10.900 and 18.300 N. During isokinetic knee extension, the tibio-femoral compressive force reached peak magnitudes of 9 times body weight and the anteroposterior shear force was close to 1 body weight at knee angles straighter than 60 degrees, indicating that high forces stress the anterior cruciate ligament. A proximal resistance pad position decreased the shear force considerably, and this position is recommended in early rehabilitation after anterior curciate ligament repairs or reconstructions.

The methods presented quantify muscle activity, sagittal knee joint moments and forces, enabling assessments to be made of different work postures, training exercises and joint derangements.

Key words: Anterior cruciate ligament, Biological models, EMG, Cybex II, Exercice therapy, Joint compressive force, Knee extension, Lifting, Locomotor system, Modelling, Moment arms, Morphometry, Muscle activity, Physical Therapy, Quadriceps muscle, Squatting, Work posture.

This thesis is based on the following papers which will be referred to in the text by their Roman numerals I-VI

I. Ekholm J, R Nisell, UP Arborelius, C Hammarberg & G Németh: Load on knee joint structures and muscular activity during lifting. Scandinavian Journal of Rehabilitation Medicine, 16: 1-9, 1984

II. Ekholm J, R Nisell, UP Arborelius, O Svensson & G Németh: load on knee joint and knee muscular activity during machine milking. Ergonomics, 28:665-682, 1985

III. Nisell R, G Németh & H Ohlsén: Joint forces in extension of the knee. Analysis of a mechanical model. Acta Orthopaedica Scandinavica, Accepted for publication, 1985

IV. Nisell R & J Ekholm: Patellar forces during knee extension. Scandinavian Journal of Rehabilitation Medicine, 17:63-74, 1985

V. Nisell R & J Ekholm: Joint load during the parallel squat in powerlifting and force analysis of *in vivo* bilateral quadriceps tendon rupture. Submitted for publication, 1985

VI. Nisell R, MO Ericson, G Németh & J Ekholm: Tibiofemoral joint forces during isokinetic knee extension. Submitted for publication, 1985

PARTITIONING OF THE L4/L5 DYNAMIC MOMENTS INTO MUSCULAR, LIGAMENTOUS AND DISC COMPONENTS FOR CALCULATION OF TISSUE LOADS DURING LIFTING

Stuart Michael McGill

A thesis
presented to the University of Waterloo
in fulfillment of the
thesis requirement for the degree of
Doctor of Philosphy
in
Kinesiology

Waterloo, Ontario

Supervisor: Robert Norman

ABSTRACT

The purpose of this work was to increase understanding of lumbar mechanics by means of the development and utilization of a sagittal plane, dynamic biomechanical model of the low back. The work was motivated by the observation that current, anatomically simple models, sometimes predict injurious levels of disc compression during human load handling when, in fact, no injury occurs. To accommadate this paradox these models often incorporate contentious compression reducing mechanisms such as intra-abdominal pressure (IAP). This author felt that the problem may be an overly simplistic representation of anatomical structure in current models and that a more realistic model would yield disc compression estimates that were well within the range of reported tissue stress tolerance values, without having to resort to unsubstantiated mechanisms.

This model incorporated extensive anatomical detail of a three-dimensional musculo-ligamentous-skeletal system. The muscle part of the model was driven from measured surface EMG and thus permitted and accounted for antagonist cocontraction. No assumptions were needed about objective functions or muscle co-activation constraints, often imposed on optimization models. The model included, in addition to the monitoring of neural activation via the EMG's, an attempt to account for: translation of the disc centre of rotation and the ability of the disc to support load during dynamic lifts; the effects of muscle length, velocity, cross-sectional area and passive elasticity on instantaneous force production; changes in muscle moment arm length throughout the range of motion of the lifts studied; curved lines of muscle force; ligament strain; the interaction of 48 muscles (or muscle laminae) and seven ligaments in supporting load. These model features partitioning of the time-history of the dynamic resultant moment, generated about an axis through the L4/L5 disc during sagittal plane lifts, into restorative components provided by the disc in bending, ligament strain and active muscle contraction. Three subjects performed 6 to 8 lifts of loads ranging from 268 to 890 N. They were all experienced weight trainers and were not told how to lift the loads. All three elected to lift with a "flatbacked" posture. In retrospect, this ultimately limited the extent of examination of model response that was possible, particularly regarding the extent of examination of model response that was possible, particularly regarding the role of the ligaments. Skeletal kinematics and the dynamic L4/L5 resultant moment were obtained from cine analysis of markers on the rib cage and pelvis input to a linked segment model. Extensive frame by frame digitizing and EMG signal processing were required for each trial.

Estimations of L4/L5 disc compression and shear were, on average, 16,2 % and 42,5 % lower, respectively, than those calculated from a commonly inplemented simple 5 cm erector tissue moment arm length. There was no need to invoke intra-abdominal pressure, lumbodorsal fascia (LDF) or other hypothesized compression reducing mechanisms. In fact, IAP and the LDF contributed no more than 4 % to supporting the peak dynamic L4/L5 moment which ranged, depending on the trial, from 250 to 450 Nm. Muscle activity, particularly that of the sacrospinalis, dominated the generation of the restorative moment. Due to the flat spine maintained through the heavy loading phase of the lifts, the ligaments played a very minor role because they were not significantly strained. Predictions of high muscle loads are consistent with the common clinical observation of muscle strain often produced by load handling.

The major contributions of this research are; 1) A much improved anatomical structure to biomechanical lumbar models, 2) An approach to studying the mechanisms of dynamic load handling which yields estimates of the time histories of trunk muscle forces and moments; which account for muscle co-activation; and which needs no assumptions about what variables may be optimized. 3) To the author's knowledge, the first attempt to partition the relative contribution of trunk musculature during the time course of dynamic lifts.

A MODEL OF THE MOTOR UNIT AND ITS IMPLICATIONS FOR THE PREDICTION OF MUSCLE FORCE DURING VOLUNTARY MOVEMENT.

Jacques Bobet

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

Supervisor: Robert Norman

ABSTRACT

Three studies were undertaken in an effort to improve models for the prediction of muscle force from the electromyogram (EMG) during voluntary movement.

In one, a model for the motor unit was developed based on the calcium dynamics and crossbridge cycle of muscle. The input to the model was a train of pulses representing the firing of the motor unit, while the output was a predicted force, ATP utilization, heat production, and number of attached crossbridges. The model's response to different conditions of muscle lenght, firing rate, firing pattern, firing durations, ATP concentration, fiber type, and contraction velocity was examined. The model's predictions were in qualitative agreement with published research for most of the conditions examined, although the predicted magnitudes of some effects differed. The results suggested that a model of this type could form a basis for a general model of muscle behavior.

In a second study, the relation of the properties of individual motor units to those of the whole muscle was examined. A set of motor units representative of those in a human finger muscle was examined. These units were then activated using published recruitment and rate coding patterns. The resulting force produced by the individual units and groups of units was compared to that produced by the whole muscle. The result indicated that different activation patterns altered the mechanical properties of the whole muscle.

In a third study, it was proposed that the rectified EMG be regarded as a measure of the average firing rate of the units within a muscle. On this basis, it was hypothesized that the best-fitting transfer function relating rectified EMG to joint moment would be a second-order, low-pass filter near critical damping, and that this transfer function would vary with the muscle's level of activation. These hypotheses were tested experimentally in two subjects. The data supported the hypotheses, although the predicted variation with activation was relatively minor. It was concluded that there was support for the proposed interpretation of the rectified EMG.

The implications of the results obtained here for the prediction of muscle force from EMG were examined. It was suggested that future models should include the possibility of an interaction between length and activation, and the possibility that the muscle's low-pass filtering characteristics will vary with length, activation, and velocity.

Calender

CALENDER OF WORLDWIDE INTERNATIONAL SCIENTIFIC EVENTS FROM 1987 UNTIL 1990

July 12-17, 1987

Caracas, Venezuela, HIth Panamerican Congress on Phys. Educ. (c/o Dr. Carlos V. Guarchia, CPEF, Apartado 10079, Maracaibo, Venezuela)

July, 13-17, 1987

International Centre for Mechanical Sciences, Centre International des Sciences Mécaniques. Bone Mechanics Advanced School coordinated by S.C. COWIN, Tulane University New Orleans. Centro Internazionale di Scienze Meccanice, Palazzo del Torso - Piazza Garibaldi, 18, 33100 Udine (Italy)

July 13-17, 1987

Athens, Greece, Fifth International Symposium of Biomechanics in Sports (c/o Secretariat of Fifth Int. Symposium of Biomechanics in Sports, Hellenic Sports Research Inst., Olympic Sports Center of Athens, 37 Kifissias Ave. Maroussi, 151 53 Athens, Greece)

Aug. 03-05, 1987

Indianapolis, USA, The Panamerican Sports Medicine Congress (c/o

Aug. 17-21, 1987

Jyväskylä, Finland, Jyväskylä Congress on Movement and Sport in Women's Life (c/o Jyväskylä Congress - on Movement and Sport in Women's Life, Fac. of Sport and Health Sciences, Univ. of Jyväskylä, 40100 Jyväskylä, Finland)

Aug. 28-20, 1987

Valkenburg, Netherlands, Symposium on human evolution. The aquatic Ape: fact or fiction? Dr. Machteld Roede, Dept. Human Biology University of Limburg P.O. Box 616 6200 MD Maastricht the Netherlands.
Phone: 31-43-888588/888595

Sept. 3-4, 1987

XIIe Congrès annuel de la Société de Biomécanique. P.M.V. Congrès/Biomécanique 130, rue de Glignancourt 75018 Paris (France)

Sept. 07-10, 1987

Prague, Czechoslovakia, 2nd Symposium on Methods of Functional Anthropology (c/o Symposium Secretariate: Salmovskà 5, CS 120 00 Praha 2, Czechoslovakia)

Sept. 8-11, 1987

Amsterdam, Holland. Second announcement and call for paper of the 7the European Conference on Biomaterials. Dr. C. de Putter, Department of Oral Implantology ACTA - Free University P.O. Box 7161 1007 MC Amsterdam, The Netherlands.

Calender

Sept. 14-16, 1987

Three-Dimensional Imaging in Medicine and Biomechanics. Acquisition, processing and display of images. M.E. Müller-Institute for Biomechanics, University of Berne, Switzerland. Organizing Committee: E. Schneider, Berne, P. Niederer, Zurich, S.M. Perren, Berne. An ESB Workshop of Methodology and Problems in Biomechanics.

Sept. 14-18, 1987

Hurdal, Norway, Pediatric Work Physiology HIII (c/o Professor Svein Oseid, The Norwegian College of Physical Education and Sport, P.O. Box 40, Kringsjaa, 0807 Oslo 8, Norway)

Sept. 16-17, 1987

Leeds, England, European Conference on Biomechancis in Sport (c/o Paul Wright, Conference Dept. C349, The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London SW1H 9JJ)

Sept. 25-26, 1987

Nort American Regional Meeting of Isek.
Location: Marriott Inner Harbor, Pratt and Eutaw Streeds Baltimore, MD 21201 1-800-229-9290 1-301-962-0202.

Sept. 28-Oct. 02, 1987

Athens, Greece, "Int. Seminar on Ergometry" (c/o Prof. Dr. V. Klissouras, Univ. of Athens, Dept. of Phys. Educ. & Sports Science, 41 Olgas Street, Dafne 17237, Athens, Greece)

Oct. 3-4, 1987

Brussels, IIIrd International Congres of LASERTHERAPY, (with a special session on cycloïd vibration therapy) in collaboration with the "European Medical Laser Association".
Information: Prof. P. LIEVENS, University of Brussels Laarbeeklaan, 103, 1090 Brussels, tel. 02/478.48.90 extension 1528.

Oct. 06-10, 1987

Calgary, Canada, Pre-Olympic Conference "Science in Winter Sport" and Annual Meeting of the Canadian Assoc. of Sp. Sc. (c/o "Science in Winter Sport" Fac. of Phys. Educ., U. o. Calgary, 2500 Univ. Drive N.W., Calgary, Alberta, Canada T2N 1N4)

Oct. 12-15, 1987

Berlin, FRG, Seminar on "Sport-Management in Europe" (c/o Führungs- und Verwaltungs-Akademie Berlin des Deutschen Sportbundes e.V., Priesterweg 6, 1000 Berlin 62, Schöneberg)

Nov. 3-6, 1987

Brussels, IVth International Congress on Sport Psychology. Université Libre de Bruxelles, Unité de Recherche de Psychologie Appliquée a l'Education Motrice. For information: Madame P. PLASCH-TOUBEAU, Université Libre de Bruxelles I.S.E.P.K. (CP 168) Avenue Paul Héger, 28, B-1050 Bruxelles, Tel. 02/642.21.80.

Nov. 26-27, 1987

Conference on Sport, Leisure and Ergonomics at Burton Manor College, Burton, Wirral, Cheshire. Dr. Thomas Reilly, Ergonomics Conference, Department of Sport & Recreation Studies, Liverpool Plytechnic, Byrom Street, Liverpool. L3 3AF.

Dec. 10-11, 1987

BIOMAT 87, Classified Tissues and Biomaterials. Bordeaux, BIOMAT, Comité d'Expansion Aquitaine 2, place de la Bourse 33076 Bordeaux Cedex, Tél. 56 52 65 47.

Dec., 1987

Lisbon, Portugal, AIESEP 25th - World Conference Human Kinetics (c/o Prof. Dr. Henrique Barreiros, Lisbon Technical University - ISEF, Estrada da Costa, Cruz Quebrada, 1499 Lisboa Codex, Portugal)

Sept. 11-15, 1988

Seoul, Korea, "1988 Olympic Scientific Congress" Theme: "Human Movement Science Toward 2000" (c/o Dr. Keung Seh-Lee, Director, Org. Comm. of the 1988 Olympic Scientific Congress, Korea Sports Science Inst., C.P.O. Box, 1106 Seoul, Korêa)

May 27-June 01, 1988

Amsterdam, The Netherlands, HHIVth FIMS World Congress of Sports Medicine (c/o Organisatie Bureau Amsterdam b.v., Europaplein 12, 1078 GZ Amsterdam, The Netherlands, Tel.: 31/20440807; Telex 13499 raico nl)

May 29-June 03, 1988

Toronto, Ontario, Canada, The International Conference on Exercise, Fitness and Health (c/o The International Conference on Exercice, Fitness and Health, c/o Ontario Group Fitness Office, 1220 Sheppard Avenue East, Toronto, Ontario, Canada M2K 2H1)

June 01-04, 1988

London, Ontario, Canada, 7th Int. Symp. on Biochemistry of Exercise, Theme: "Biochemical Strategies in Response to Altered Functional Demands"
(c/o Dr. A.W. Taylor, Fac. of Phys. Ed., Univ. of Western Ontario, Thames Hall, London, Ontario N6A 3K7, Canada)

July 18-22, 1988

Paris, France, 12 th IMACS World Congress on Scientific Computation (c/o The Secretary 12th IMACS World Congress, IDN, BP 48, 59651 Villeneuve D'ASCQ CEDEH, France)

July 24-31, 1988

Zagreb, Yogoslavia, 12th International Congress of Anthropology and Ethnological Sciences (c/o Laboratory of Anthropology, Institute for Medical Research and Occupational Health, Mose Pijade 158, P.O. Box 291, 41000 Zagreb, Yugoslavia, tel. 041/432-186 of 432-286)

Jan. 28-Febr. 02, 1989

Auckland, New Zealand, The IH Commonwealth and International Conference (c/o Conference Convenor 1990, Ms. Rosalie King, Auckland College of Education, Private Bage, Symonds St., Auckland, New Zealand)

1989, (date to be fixed)

International ISAK-Congress "Kinanthropometry IV"

Laboratory Feature

PHYSICAL THERAPY EDUCATION

The University of Iowa
Iowa City, Iowa 52242
Physical Therapy Education
2600 Steindler Building
(319) 335-9791

Gary L. Soderberg, LPT, Ph.D.
Director and Professor

Neuromuscular

The general theme of research conducted in the neuromuscular laboratories is to evaluate the effects of various types of somatosensory stimulation in modulating alpha motoneuron excitability. Investigations incorporate measurements of primarily the spinal reflex pathways or the discharge patterns of single motor units. This requires development of skills and knowledge specific to the techniques of EMG recording and analysis and neurophysiological stimulation. The general clinical situation to which this research is related is to describe the effects a physical therapist exerts on motoneuron excitability when handling a patient. The research questions formulated therefore focus on three areas: (1) the description of motoneuron excitability changes due to somatosensory stimulation, (2) the identification of specific sensory receptors and central nervous system mechanisms responsible for the excitability changes, and (3) the application of this information to the validation, improvement and/or development of neuromuscular therapeutic techniques.

Musculoskeletal

A multifaceted approach is being used to study physical impairment, particularly with respect to low-back dysfunction. Factors being studied are posture, joint motion, gait, pain, anthropometry, muscle strength and endurance. Computerized systems for posture, joint motion, gait, muscle strength and endurance are operational. The most recently completed system is the Kin Com trunk testing unit involving study of the isolated trunk and spine in terms of motion, strength and endurance. In this system, transducers for measurement of force, motion and muscle activity (EMG) are integrated with a PDP 11/34 computer. A study of muscle stiffness is in the formative stages of development.

The emphasis in the studies is to identify relevant means of helping determine physical impairment and effects of therapeutic intervention.

Movement Analysis Laboratory

Activities in the Movement Analysis Laboratory are directed at investigating the neuro-musculo-skeletal aspects of functional activites, particulary occupational activities. With support from the National Institute for Occupational Safety and Health a project is underway to study the effects of low back muscular fatigue on selected kinematic and kinetic features of lifting tasks. Included in this study is a determination of muscle fiber composition of the paraspinal muscles and an examination of the relationship between fiber composition and the rate of fatigue during lifting.

In cooperation with the Department of Biomedical Engineering a study has just been completed on how the use of pneumatic hand tools affect vibratory perception thresholds. Subjects for this investigation included normal subjects as well as workers from two different foundries.

Seating systems for both able-bodied and disabled individuals is also an active area of research in the laboratory which has been supported by private foundations and private industry. A computerized ischiobarograph has been developed and used to investigate various seating options relative to the use of lumbar supports, seat pan angles, backrest angles, etc. for wheelchair users. These techniques along with longterm monitoring of postural EMG are being used to evaluate various ergonomic factors associated with the design and use of office furniture.

The occupational focus of laboratory activities has been recently reinforced by involvement in an interdepartmental $1.3 million three year award from the Kellogg Foundation for development of a "Comprehensive Occupational Disease Prevention and Health Promotion Program". Physical Therapy will be the major resource for this program in regard to identification, treatment, and prevention of ergonomically related musculoskeletal accidents and injuries. It is anticipated that several applied ergonomics research projects will develop from participation in the outreach activites associated with this grant.

Bookreviews

TRAINING AND TECHNIQUE IN SPEED SKATING

a biomechanical and exercise physiological study

R.W. de Boer

Note from the Editor: This Book is the Ph. D. thesis of R.W. de Boer

SUMMARY

In chapter 1 the literature on speed skating is shortly reviewed and the startingpoint and the aim of the study are outlined. The power balance approach was used to investigate physiological and biomechanical aspects of speed skating. The external power delivered by the skater (equal to the amount of work per stroke times stroke frequency) is used to overcome frictional losses and to change the kinetic energy. The aim of the present study was to investigate in detail two factors which are importnt for the present study was to investigate in detail two factors which are important for the optimalisation of the external power output:
1. Push-off mechancs
2. Specific training activities

In chapter 2 the push-off mechanics and the control of speed were studied. From ten participants in the Ladies Speed Skating World Chamionships mechanical parameters were measured and correlated with speed and external power. The parameters were derived by means of film and video analysis of strokes at the four distances. It was shown that these speed skaters control the different speeds at the different distances mainly by changing their stroke frequency and not by changing the amount of work per stroke. However, at the same distance the relatively small interindividual differences in performance appeared not to be correlated to differences in stroke frequency but were correlated to differences in push-off mechanics. Better performers showed a more horizontally directed push-off in the frontal plane. The limited knee extension range caused by the absence of plantar flexion is characteristic for the speed skating push-off.

In chapter 3 it was explained that the amount of work per stroke is dependent on the component of the push-off force in the direction perpendicular to the gliding direction of the skate. One stroke consists of a gliding phase and a push-off phase in which the knee is explosively extended. Characteristic stroke mechanics of elite and trained male speed skaters were studied by means of high speed cinematography from two positions. The better skaters showed a higher power production. No differences in stroke frequency were observed. The differences in performance were related to the differences in push-off mechanics (work per stroke). The faster skaters reached a higher knee angular velocity, the push-off time was shorter. At the onset of push-off, the velocity of the body centre of gravity (c.g.) in the horizontal direction is higher due to a longer 'passive falling' movement in the frontal plane. It was concluded that the skaters show a better timing that results in a more explosive and effectively directed push-off. The results emphasisze the importance of an optimal co-ordinated pattern in speed skating.

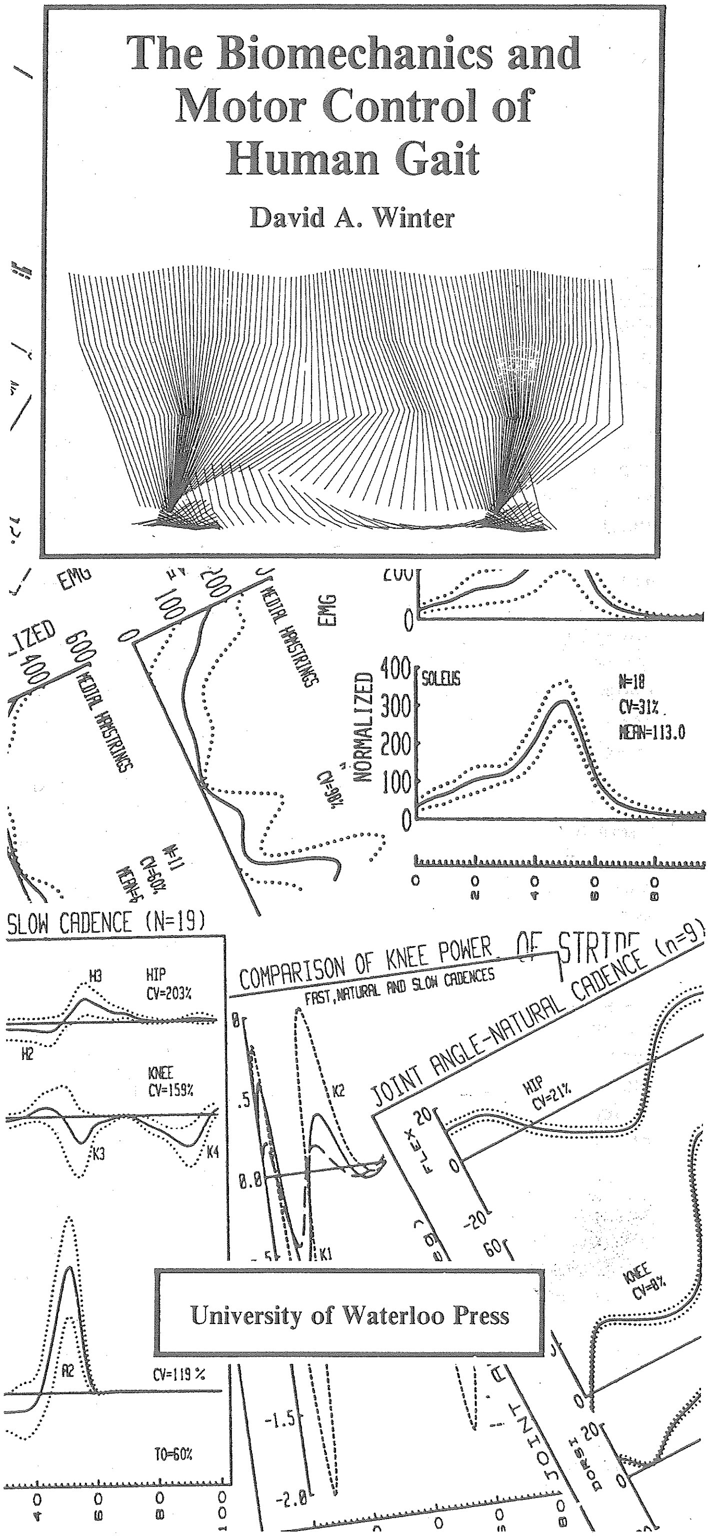
The biomechanics of the push-off technique in speed skating the curves was investigated in chapter 4. In contrast to the straight parts the stroke frequency and the work per stroke in the curves can not be freely choosen by the skater. Film and video analysis from the 5000 m races at the Dutch National Championship for men yielded biomechanical variables which were correlated to performance. The high speed and power output of the better skaters was a result of a high amount of work per stroke, caused by the short and effectively directed push-off. The left leg stroke showed a more powerful push-off than the right leg stroke. These results strongly support the findings of chapter 2 and 3 that skaters of different performance level can be distinguished by differences in amount of work per stroke (push-off mechanics) and not by differences in stroke frequency.

In chapter 5 it was shown that the external power of a skater in the curve can be computed directly. The centripetal force in speed skating the curves has to be delivered by the push-off force which also does the external work to maintain the speed. Based on the geometrics of the speed skating oval and the sidewards push-off characteristics in speed skating, a geometrical model of the power output in skating the curves was deduced. The power required to follow the curve is dependent on the mean speed in the curve, the work per stroke and the radius of the speed skating oval. Measurements during the 5000 m races at the European Championship for ladies yielded on the one hand power from the geometrical model and on the other hand power losses due to friction. The difference between power delivered and power needed to overcomte friction is used by the skaters to increase their speed. The difference between predicted and measured power used to increase the kinetic energy of c.g. was only 3 %. This close agreement is a strong argument for the validity of both models used. It was discussed that skaters who want to accelerate in the curbes should increase their work per stroke and that tall skaters have some advantage in accelerating during the curves.

In chapter 6 and 7 two studies based on the concept of training specificity are presented. Roller skating, dry skating (side to side deep sitting push-offs) and low walking (walking like movement in skating position) were compared with speed skating by means of phisiological (VO_2, V_E, RQ, heart rate) and biomechanical variables. There was no significant difference in the oxygen uptake between speed skating and roller skating. In roller skating a higher RQ was found. Power, work per stroke and stroke frequency were equal. Due to a higher friction coefficient, the maximal roller skating speed was lower. The effectiveness of the pus-off and parameters concerning speed skating technique showed no differences. In roller skating a 7,5 % higher angle of the upper leg in the gliding phase was found. It was speculated that the blood flow through the extensor muscles might be higher in roller skating. It was concluded that roller skating can be thought of as a specific training method for trained speed skaters in the summer period.

The oxygen uptake in low walking was not significantly different to that achieved during speed skating, but the maximal level attained in dry skating was significantly less than both of these. The biomechanical characteristics of low walking and dry skating showed substantial differences to those of speed skating. Thus it is not possible to justify inclusion of these activites in non-ice period training programmes on the grounds of close specificity - at least insofar as short and maximal performances are concerned. Some of these differences are inevitable (e.g. forwards propulsion and use of plantar flexion in low walking; and fixed push-off position in dry skating), whereas other variables (e.g. the avoiding of plantar flexion in dry skating) can be influenced by proper coaching.

Finally, in chapter 8 two well trained speed skaters were subjected to a biomechanical analysis incorporating push-off forces, cinematographic data, EMG and link segment modelling in order to gain more knowledge regarding the background to technique and performance in speed skating. In speed skating during the puss-off the c.g. us accelerated with respect to the point of application of the pus-off force. The velocity of c.g. is a result of rotation of segments. Due to the absence of plantar flexion of the foot the knee extension range is limited. This appeared to lead to an extremely short lasting push-off. The short and explosive push-off can be considered as a catapult-like action. The knee extensor muscles vastus medialis and rectus femoris are pre-strechted in the gliding phase by an antagonistic action of gastrocnemius and biceps femoris. In this phase the skater rotates his c.g. from the lateral to the medial side of the skate in order to reach a more horizontally directed push-off. After relaxtion of m gastrocnemius and hamstrings a large angular acceleration of the knee is observed resulting in a high extension velocity. The power output in the push-off phase is mainly generated by the mono-articular extensor muscles gluteus maximus and vastus medialis.



Detailed Topics

1) A glossary of terms, definitions and conventions.
i) Gait specific terminology, *i.e.,* stance, heel contact.
ii) Biomechanical, anatomical and neurological terms that apply to gait.
iii) Recommended conventions and abbreviations for use in the description and analysis of gait.

2) A handbook of normative data on a widge range of gait variables.
i) Temporal, cadence and stride length measures.
ii) Kinematic variables over the stride period: joint angles, limb velocities, accelerations and trajectories.
iii) Kinetic variables over the stride period: reaction forces, moments-of-force, power, energy.
iv) Electromyographic variables over the stride period: from 16 major muscles.

Full intra and inter-subjet curves are presented at three walking cadences: slow, natural and fast, and measures of variability are reported. A full description of each family of curves is presented and an interpretation is offered. On some of the more important baseline curves (moments-of-force, joint angles, etc.) a table of values is reproduced so that the user may input those curves into his or her computer without the error and labour of trying to read values off the graphs.

It is recognized that the 3-D data analysis of level walking is not yet fully documented nor are normal profiles available for special gait patterns: walking up and down stairs, running, walking backwards, and so on. Future editions of this text (commercing in 1989) will document those additional aspects of human gait.

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THE VOLVO AWARDS FOR LOW BACK PAIN RESEARCH 1988

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Papers submitted for the contest must contain **original** material, not previously published or submitted for publication. A multiple authorship is acceptable. The manuscripts should be in the form of a complete report, includingg original illustrations, not exceeding 30 typewritten pages, double-spaced, and in a form suitable for submission to a scientific journal. Six copies of each paper submitted in full should **reach the address given below not later than November 15, 1987.**

One of the authors should be prepared, at his own expenses, to come to Miami, Florida, USA, at the time of the meeting of the International Society for the Study of the Lumbar Spine, April 12-16, 1988, to present the paper and to receive the award.

The board of referees will be chaired by the undersigned and will contain members from the fields of clinical medicine, bioengineering and biochemistry.

Please direct all correspondence to:

Professor Alf Nachemson
Department of Orthopaedics
Sahlgren Hospital
S-413 Göteborg, Sweden

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