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Editorial

The last few months have been very busy for most of us. Many conferences, Formia (Biomechanics), Glasgow (Sportscience), Brussels (Physical Education), Montreal (Biomechanics), Wingate (Recreation), Bielefelt (Biomechanics-Swimming), Mons (Biomechanics), Berlin (Biomechanics), Brisbane (Sportmedicine), Athens (Exercise Physiology), Seoul (Sportscience)... have been organized within a period of 90 days. Many of us attended to a number of these and the northern Summer part of the globe had to combine one or more of these conferences with his/her summer holiday.
The reader of this Newsletter may remark that so many conferences in such a short time may be a little too much, and we certainly aggree with him/her.
There are a number of societies in our small scientific world that could coordinate theirs different initiatives because the have a numer of scientific areas in common and sometimes overlapping... try yourself and you will be surprized how many societies - directly of inderectly related to each other - that you know (ISB; ESB; ASME; ASB; CAS; FIMS; ICSSPE; FIEP; ISEK; ISAK;...).
A number of these societies have their onw Newsletter with the same problem... you guessed it...
A LACK OF COPY!

All though we should not complain (because we had no problems last 12 months) the reader will miss a number of items inthis Newsletter. We have no "You should know", we have no "Bookreview", we have no "Past Conference News" (!!), we have no "Laboratory feature", but we give you a series of Thesis Abstracts in stead.

Therefore, many thanks to those who have sent us this material form the University of Strathclyde, Glasgow (8), Pennstate University (2), The Univerisity of Iowa (1), The University of Calgary (1), The University of Linköping (1).

J.P.C. J.C.

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- laboratory future,
- original articles,
- past conference news,
- conference announcements,
- etc....

to: Dr. J.P. CLARYS
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THE ISB NEWSLETTER IS THERE FOR YOU!

Thesis abstract corner

THE PENNSYLVANIA STATE UNIVERSITY
THE GRADUATE SCHOOL
DEPARTMENT OF PHYSICAL EDUCATION

PLANTAR PRESSURE DISTRIBUTION MEASUREMENTS DURING BAREFOOT WALKING: NORMAL VALUES AND PREDICTIVE EQUATIONS

A Thesis in
Physical Education
by
Mary McIntyre Rodgers

Submitted in Partial Fulfillment
of the Requirements
for the Degree of
Doctor of Philosophy
December 1985

ABSTRACT

This study was conducted in order to establish normal pressure values for comparison to a pathological sample, and to construct a predictive model of pressure data. A 1000 element piezoceramic pressure platform was used to collect plantar pressure data from 60 male subjects, 40 tot 81 years of age. Subjects were age and gender matched to a previously completed pilot study of diabetic subjects. Three trials of data were collected from one foot of each subject during two conditions: (a) first step onto the platform from a standing position, and (b) mid-gait step onto the platform. Walking speed for the mid-gait collection was kept within a range of 1.3 m/s ± 2 %. The regional peak pressures and impulses were determined from the data collected. Physical measurements were taken from each subject and incorporated in regression analyses. These measurements included body weight, body height, leg length, foot width, foot length, first ray mobility, arch index, percent body fat, and age.

Body weight, arch index, and body height were the strongest predictor variables for regional plantar peak pressure and impulse of the variables used in this study. The best prediction ability was for the arch region impulse equation for both conditions (first step and mid-gait). Equations for the ball region were able to explain approximately 30 % of the variability of the value being predicted. Although the regression equations for the arch, ball, and toe regional peak pressures and impulses represent the frist attempt in prerdicting pressure form other parameters, they provided only limited prediction abilities.

The regional peak pressures and impulse values provide a database of normal values for the first step condition and for the mid-gait condition. The upper limit for males who are 40 years or older can be obtained for each region and both conditions form this database. Based on the 95 % confidence limits, the upper limit of normal over all regions would be 519 kPa for peak pressure and 33 % for impulse. These values should serve as a guide to those investigating plantar pressures in pathological populations.

In general, results suggest that inference from first step data to mid-gait data is feasible using ration relationships. For seven of the then anatomical regions, the peak pressures were slightly higher during mid-gait tha during first step collection. The regional mid-gait peak pressures were an average of 1.1 times as high as those of the first step condition. The ball region peak pressures were only 5 % higher in the mid-gait condition. The impulse values were slightly higher during first step for the medial midfoot region, and also slightly higher during mid-gait for the second and lateral toe regions. In this respect, the impulse values were more comparable between the two conditions than the peak pressures.

THE USE OF AUGMENTED FEEDBACK FOR THE MODIFICATION OF THE RIDING MECHANICS OF INEXPERIENCED CYCLISTS

A Thesis in Physical Education
by
David John Sanderson
(Peter R. Cavanagh, Advisor)

Submitted in Partial Fulfillment
of the Requirements
for the degree of
Doctor of Philosophy
May 1986

Forces applied to the pedals were used to generate a visual image to be used to train a groupe of cyclists to modify their pattern of force application. The system used included instrumented pedals mounted on a stationary bicycle frame, a minicomputer with a 12-bit analog-to-digital converter, and a graphics computer. The cyclists were instructed to modify their riding mechanics to minimize the forces applied to the pedals during a 90-degree segment of the recovery beginning at a crank angle of 225 degrees after top dead center. The cadence was 60 RPM and the average power output 112 watts. The subjects rode for 32 minutes each day for 10 days. During these training rides, the control group (n = 4) was given feedback on their pedalling rate only, while the experimental group (n = 4) was presented wit feedback (KR) on their pattern of force application as well as pedalling rate. To prevent the experimental group from becoming dependent upon the visual feedback of the applied forces, the image was presented ant withdrawn on a regular schedule. There was more feedback early in the training schedule than later. For each day of the training sessions, the mean force applied to the pedals was recorded. For the experimental group it was possible to partition the means into the intervals with and without feedback.

To assess the impact of the visual feedback on the cyclists' ability to alter their pedalling mechanics, the mean force apllied to the pedale during the 90-degree segment was computed during a pre-test, a post-test immediately following the end of training (post-test 1), and a post-test immediately following the end of training (post-test 1), and a post-test seven days later (post-test 2). In addition, the pattern of force application for the whole pedalling cycle was computed. Only information on cadence was given to the groups during these tests.

The experimental group significantly ($p<.05$) reduced the recovery forces between the pre-test and post-test 1. There was no difference in mean pedal force between the post-test 1 and post-test 2. There were no significant between group differences. The expereimental group reduced their pedal forces almost to the final values within the first day.

Three of the four subjects in the experimental group showed no loss in performance when the KR was removed. The fourth subject had considerable difficulty completing the task without the KR. The KR appeared to facilitate the acquisition of the new skill in the early stages. Because of the lack of difference between the mean forces computed in the intervals with and without feedback, it was speculated that the group used the KR initially to solve the task requirements. After that, the KR was used only as a check to ensure that there had not been a decrement in performance.

Analysis of the pattern of force application, through the complete cycle, showed that as a result of training sessions modifications of the recovery force resulted in a reduced propulsion force. This statisfied the requirements of the task that the pedal rate and power output remain constant. The reduced recovery forces implied that the subjects were not working against themselves as hard as before the training sessions began.

It was concluded that (a) performance of a complex task can be modified by feedback of a biomechanical nature, (b) visual feedback of pedal forces assisted the experimental group in achieving lower forces more rapidly than the control group, (c) the presentation and removal of feedback can assist subjects to form an internal representation of the taks without including the augmented feedback, and (d) the reduction of the pedal forces in the recovery resulted in reduced pedal forces in propulsion. It was speculated that this reduction would result in an improved economy of riding.

THE UNIVERSITY OF IOWA

INDIVIDUAL MUSCLE FORCE PREDICTION IN ATHLETIC MOVEMENTS

by
Walter Herzog

A thesis submitted in partial fulfillment of
the requirements for the degree of Doctor
of Philosophy in Physical Eduction
in the Graduate College of
The University of Iowa

May 1985

Thesis supervisor: Professor James G. Hay

ABSTRACT

The purposes of this investigation were (a) to predict individual muscle forces for maximum effort knee extension exercises using nonlinear optimization mathematics and different objective functions and (b) to estimate the accuracy of these predicted force magnitudes.
One male subject executed maximum effort knee extension exercises on a CYBEX II machine. The knee joint torques (T_k) were calculated from the torques measured by the CYBEX machine (T_c) and film records of the knee extension experiment.
The subject's right leg ws modeled as a system consisting of rigid bodies connected by smooth joints. With the help of this model the knee joint torques (T_{km}) were calculated again. To reduce the differences between T_k and T_{km} an optimization algorithm with the objective to minimize the function

$$\psi = \sum_{i=1}^{n} (T_k - T_{km})^2$$

was used to obtain the final model.
The forces for the quadriceps muscles were then predicted using a nonlinear optimization approach and three different objective funtions:

Minimize: $\phi_1 = \sum_{i=1}^{4} (F_{pi}/PCSA_i)^3$ $\phi_2 = \sum_{i=1}^{4} (F_{pi}/F_{maxi})^2$ $\phi_3 = \sum_{i=1}^{4} (F_{pi}/r_i\ F_{maxi})^2$

To evaluate the results, the forces predicted were compared to the forces obtained using the final model -- the model forces -- and assuming that each muscle was maximally active throughout the experimental movements.
The force predictions using the first objective function yielded reasonable results for slow movements with a small range of motion. The force predictions using the second and third objective functions yielded reasonable results for slow and fast movements and for the whole range of motion of the knee extensions as long as the model forces for the individual muscles were of similar magnitude.
The results of this study were obtained for a specific type of muscle contraction -- a maximum effort concentric contraction. This was necessary to permit comparison of the forces obtained using the nonlinear optimization algorithm and the model forces. Future work should concentrate on testing whether the findings of this study may be generalized to submaximal concentric and eccentric contractions of human muscles.

THE UNIVERSITY OF CALGARY

BIOMECHANICAL ANALYSIS OF SHORT TERM PAIN AND INJURIES IN TENNIS.

Author: *S.M. Luethi.*
Supervisor: *B.M. Nigg.*
Department: *Medical Sciences.*

The number of cases of pain and injuries in tennis has drastically increased over the last two decades. However, very little is known about the numerous factors causing the injuries or pain. Most of the statements concerning the etiology of pain in tennis are assumptions or suspicions and the purpose of this project was to study the etiology of pain and injuries in the lower extremities which are caused by playing tennis.

Basic considerations concerning the load on the musculoskeletal system explain that the load is compounded by the movement performed while playing tennis and by the boundary conditions. Information concerning negative effects of load on the musculo-skeletal system which result in pain and injuries is usually gathered from subjects who already have suffered pain and injuries. The method used in this study was a "prae factum" approach (prospective study), i.e., all the information concerning movement and boundary conditions is collected from healthy subjects were affected by pain and/or injuries. Their results were then compared to the results of the subjects who suffered no pain or injuries.

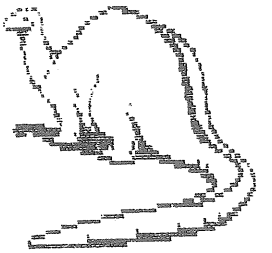
To understand the etiology of pain in tennis the kinematics of movement and external boundary conditions (two types of shoes with low and high friction coefficients) were studied. In this respect a questionnaire was completed by each subject after each playing session. The description of the movement patterns (biomechanical aspect) was carried out with a Kistler force platform and a Locam II high speed camera. A subject performed three types of movement; running, running-stopping and hopping sideways. The force platform measured the external forces while the high speed film data were used to measure the touch-down angle and velocity of the lower leg, the achilles tendon angle and the rearfoot angle.

Out of the 171 players who completed all the requirements for inclusion in the final analysis, 68 of 40% reported pain. The most common sites for pain were: toes (37 subjects), forefoot (24), heel (14), arch (12) and ankle (7). The foot was the site where pain was most often reported (85%). Pain was frequently reported in the first two playing sessions and less frequently afterwards. Players wearing the harder shoe 2 reported pain more frequently (47.1%) than the players wearing the softer shoe 1 (32.6%).

The biomechanical analysis resulted in consistent findings for the three movements studied. Shoe 1 showed higher lateral forces and greater amount of inversion, while shoe 2 restricted the lateral movement of the ankle (small inversion) which was connected with increased occurence of pain.

All three movements had variables which showed differences for the pain and no pain groups. Running had four variables which showed differences for the subgroups. The frequency of occurrence of vertical impact peaks and the initial pronation had higher values for the pain group for shoe 2. The total inversion and the total inversion-eversion showed higher values for the pain group for shoe 1. Running-stopping showed for both shoes a higher maximal a-p force, a higher a-p touch-down velocity, a lower vertical touch-down for the pain group. Hopping sideways showed optimal ranges for the total inversion (supination) of the foot during the first 50 msec and for the total inversion (supination) during heel contact. In addition, the inversion during toe contact only showed lower values for the pain group for both shoes. It is felt at this point of time that sideways hopping is the movement which provided the best information for the etiology of pain in tennis. The finding of optimal ranges of inversion during that movement is new and may contribute to the understanding of the etiology of pain in tennis.

In this study, high forces were not the primary causative factor in the occurrence of pain. This is probably due to the fact that only short-term influences were assessed with this short-term study. The findings of this investigation were mainly related to the pain associated with wearing new tennis shoes. The results of the present study suggest the assumption that the type of footwear worn and the subject's ability to adapt to the shoe contribute significantly to the occurrence of pain.



THE LINKÖPING UNIVERSITY

Department of Industrial Ergonomics and
Department of Clinical Neurophysiology
Linköpring University
S-581 83 Kinköping, Sweden

ON ANALYSIS AND CLINICAL MEASUREMENT OF GAIT AND UPRIGHT STANCE

by
Per Odenrick

Roland Örtengren and
Lars-Erik Larsson, supervisors

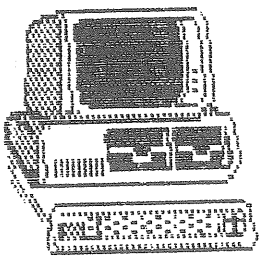
ABSTRACT

Gait and upright stance were analysed in normal subjects and patients with movement disorders. Clinical measurement methods were designed and the results were analysed by using mathematical models relevant for the clinical problem. Foot switch recordings were used to measure basal gait characterictics such as walking speed, stride length, stride frequency, and the temporal phases of the stride. Upright stance was evaluated by measurements of body segment displacements and ground reaction forces. The methods were designed to put a minimal load of equipment on the patient. All measurement equipment is integrated in one laboratory and the measurement process is controlled by the software in a minicomputer.

The influence of walking speed upon the measured variables was analysed and a linear regression model was proposed for making intra and interindividual comparisons at different speeds. The interaction between the phases of the stride was described by linear equations. Body sway in upright stance was measured as the displacements of the centre of pressure between the feet and the ground. The displacements were quantified by statistical signal theory based on the assumption that the sampled signals are normally distributed. A three segmental biomechanical model for the body in upright stance was developed. The model is dynamic and describes the body by inverted pendulums placed upon each other.

The designed methods were used to investigate the development of gait and upright stance in the normal child and in spastic children. Gait and upright stance were also investigated in strabismic children. The role of the ankle joint in single limb stance was evaluated in soccer players. The capacity of the postural control system was studied by means of loading subjects with wieghts.

The work emphazises the importance of using models in clinical analysis of human movements and adapting these models to meet the clinical problem.



THE UNIVERSITY OF STRATHCLYDE
DPT. BIOENGINEERING

ORGAN CULTURE FOR THE EVALUATION OF BONE SUBSTITUTE BIOMATERIALS

D.E. BESSANT, B.SC.
May, 1984

SUMMARY

"Organ Culture" is a term that denotes the maintenance or growth of tissues, organ primordia, or the whole or parts of an organ in vitro in a way that may allow differentiation and/or preservation of the architecture and/or function of the organs. This study was designed to adapt a previously developed technique so that it could be applied to the biocompatibility testing of implantable materials. The feasibility of the technique was determined by measuring the effect of a new biomaterial, Controlled Release Class (CRG), on the growth of the cultured organs, chicken embryo lower limb rudiments.

The final modification of the technique resulted in the cultured organs almost doubling in length over the allotted growt period, even in the presence of CRG.CRG was seen to have a possible detrimental effect on the increase in the lengths of the cultures and to markedly increase the wet weights of the cultures without affecting their dry weights.

This technique is thougt to have great potential in the biocompatibility testing of biomaterials but only if employed in conjunction with other methods, such as those used in analytical chemistry. Parallel in vivo testing should also be carried out on the test material if a more conclusive set of results is to be obtained. The relative inexpensiveness of the technique is one of its great strenghts and it would definitely prove useful in the initial screening tests of a new biomaterial.

MSc Thesis

AN APPROACH TO FINITE ELEMENT ANALYSIS OF SELF-LOCKING TAPERS

Philip John ROWE B.Sc.
September 1984

ABSTRACT

For the last 40 years surgeons have attempted to replace large segments of long bones destroyed by tumours, disease or trauma. Until recently these devices have been custom-made for each patient but as the results improve so the numbers of patients treated this way are rapidly increasing. Modular systems which would speed the time to surgery and permit greater flexibility at operation are being evaluated in several centres. This project studied the self-locking taper which is to connect the components in the Glasgow system.

Taper systems have been modelled using a finite element package. The interface of such a system is difficult to model and various techniques have been explored using a simplified two dimensional treatment. A satisfactory technique was eventually established and the effects of changing taper geometry and materials investigated on two dimensional models.

Because the graphical output from the package was inadequate a special graphics program was constructed using the GINOF graphics package. An axisymmetric three dimensional model was compared with the two dimensional treatment although time did not permit the full three dimensional model to be completely developed. The characteristics of such a model and the analysis routines required are discussed.

M Sc Thesis

COUPLED GAS TRANSFER IN TUBULAR MEMBRAME OXYGENATORS

Simon Mark Williams, B.Sc. (Hull)
September 1984

ABSTRACT

The artificial lung is a major component of cardiopulmonary bypass (CPB) circuits for open heart surgery. In acute respiratory failure (ARF) it may provide long term support of the natural lungs. Further development of artificial lungs is desirable to improve their efficiency and to reduce the cost.

This thesis is concerned with theoretical aspects of coupled oxygen (O_2) and carbon dioxide (CO_2) gas exchange in blood flowing in a permeable cylindrical tube. Parallel arrays of such tubes comprise artificial lungs know as hollow fibre membrane oxygenators. Currently several major medical equipment manufacturers are developing hollow fibre devices aimed for CPB or ARF applications.

The convective-diffusion equations and dissociation theories for O_2 and CO_2 exchange used by earlier investigators

were reviewed. The transfer of both gases has previously been assumend independent and diffusion of bicarbobante CO_2 has been ignored in the majority of cases. This outcome prompted the development of a coupled or simultaneaous set of convective-diffusion equations which include bicarbonate diffusion, using a dissociation theory which accounted for Bohr and Haldane effects. The coupled equations were modified and solved by the method of lines using NAG subroutines on a Digital VAX 11/782 computer. The theoretical results were presented in terms of tube axial profiles of cupmixed O_2 saturation and dissolved CO_2 content for a set of standard input conditions and neglecting the resistance of the tube wall.

The profiles for O_2 saturation revealed the importance of adequate modelling of the steep O_2 partial pressure gradient near the walls of the tube. Those for the dissolved CO_2 content predicted higher CO_2 levels for the coupled case as opposed to the uncoupled case. The Bohr and Haldane effects were observed in the profiles.

THE FUNCTION OF THE UNIAXIAL PROSTHETIC FOOT

Jeremy Ralp Linskell B.Sc.

September 1984

ABSTRACT

In order to describe the function of the uniaxial foot of a prosthetic limb during locomotion, the dorsiflexion arm and the plantarflexion arm of the foot-ankle adapter of a moulded uniaxial foot were individually strain gauged in order to measure separately their contributions to the total moment acting at the foot/ankle complex. A flexible goniometer was also installed in order to measure the angular variation of the foot-ankle adapter relative to its attachment to the shank during locomotion. A series of thin, membrane type foot switches were placed along the lenght of the foot in order to temporally map the progression of the foot during stance phase.

From the output of these devices, it was found that the function of the prosthetic foot-ankle complex, could be described as being composed of four phases. These phases were;

1) plantarflexion of the foot relative to the ankle-foot adapter at heel strike;
2) movement of the foot to foot flat position, during which time the plantarflexion moment continues to rise;
3) a fall in the plantarflexion moment and a rise in the dorsiflexion moment as the ground reaction vector passes through the ankel axis and the amputee attempts to pivot over the prosthetic ankle;
4) and, a sustaining of the dorsiflexion moment for the initiation of toe brake.

From the data obtained it was found possible to quantify the general action of the uniaxial foot-ankle complex by temporal parameters if a switch could be placed between the dorsiflexion arm of the foot-ankle adapter and the dorsiflexion stop, in order to register the rotation of the foot-ankle adapter.

Due to the dynamic response of the transducers it was found possible to isolate certain characteristics of the ankle moment. These implied that above-knee and below-knee amputees used the uniaxial foot in different ways, although it was not possible with the limited data to quantify these characteristics.

EVALUATION OF A NEW COLLAGEN WOUND COVERING IN VITRO

Sunday C. UMERIE (B. Sc.)

Sepember 1984

ABSTRACT

At injury, the integrity of the skin is disrupted and consequently some vital barrier functions are lost. The body normally acts to repair the wound by the intricate physiological process of wound healing. For optimal healing, a moist and bacteria-free environment is required and this cas be achieved by the use of a suitable temporary wound covering or dressing.

A new bilayer composite wound dressing, which consists of a permeable collagen/alginate tissue interface layer and a semipermeable polyurethane cover film, has been developed at the University of Strathclyde. This composite wound dressing (CWD) was evaluated in vitro, to establish some of its physical properties; bioelectric parameters, water vapour transmission rate, fluid absorption charachteristics as well as rate of release (or degradation) of the soluble component of the dressing.

The results show that the material has good physical properties. It has a high tensile strenght, and a rupturse strain of about 780 per cent. It manifested some bioelectric parameters which will encourage the development of, or enhance the interfacial potential which normally is established between the rapidly profilerating epidermal cells and the material in the wound microenvironment. It has a water vapour transmission rate slightly higher than that for normal skin. Both the rate of fluid absorption and its capacity (42-62 ml/gm) were high. The rate of solute release was highly favoured by high pH environment and possibly by the pressence of dissolvend substances in the test fluids.

Further clinical studies on a variety of wounds are therefore required to establish its efficacy as a suitable temporary wound covering.

AN INVESTIGATION OF PARAMETERS FOR KNEE JOINTS OF ARTIFICIAL LEGS

Maire Doran B. Sc.

September 1984

ABSTRACT

Although a great number of knee mechanisms for artificial legs have been designed and a lot of research has been done in this area of prosthetics, only a few standard type mechanisms are in common use. There is obviously a need for new designs but at present none have adequately satisfied the requirements necessary to obtain large scale use. The lack of a comprehensive set of design specifications indicated the need for this project to concentrate on the investigation of the design requirements of a prosthetic knee mechanism.

A background study of lower limb prosthetics and gait analysis is presented.

Reviews of present-day prosthetic knee mechanisms and recend developments in knee design and control are also presented.

A biomechanical assessment of three conventional knee mechanisms on four subjects was performed. The methodology and instrumentation used is given and results discussed. It was found that requirements are largely patient dependent.

A questionnaire survey of amputees was carried out. A complete set of results and a discussion of relevant findings is given. Amputees complaints about their limbs, suggestions for improvements to the knee, and their functional requirements are presented.

Since the project is an investigation towards further research and design, ideas are presented for further work, for short term improvements and for ideal knee mechanism function.

M Sc Thesis

Physiotherapy Department
Institute of Neurological Sciences
Southern General Hospital
Glasgow, UK

THE MEASUREMENTS OF RISING TO STAND AND SITTING DOWN IN HEMIPLEGIC PATIENTS

Brian R. Durward.

A Thesis submitted to the
Bioengineering Unit of the University of Strathclyde
for the degree of
Master of Science, by Research.

ABSTRACT

Within current neurological physiotherapy practice few methods exist for objective measurement of recovering hemiplegic patients' movement performance. Methods are needed to provide knowledge of the effectiveness of existing treatment strategies, patient learning patterns, and the possible benefits from adopting alternative approaches to hemiplegic patient care.

The overall aim of this investigation was to establish and validate a simple method for measuring a specific functional movement (standing up from a chair and sitting down), in patients with hemiplgia due to cerebovascular disease.

A platform consisting of two separate load transducers was used to measure the load transmitted through each foot during the movement sequence. Transducer signals were amplified by strain gauge amplifiers and load changes were recorded using an Ultra Violet Galvanometer recorder. Movement performance was measured on twenty occasions at intervals of one week and recorded movement traces were interpreted using a defined protocol. Measurable movement parameters were identified and their changes noted during the treatment process. The patient group (N = 11) consisted of patients with recently acquired hemiplegia and their performances were compared with two normal hemiplegia and thei performances were compared with two normal groups, a young group (N = 12) and an age-related group (N = 12).

Three parameters were shown to alter during treatment, (MEI_1 a measure of movement efficiency, WDR_1% and WDR_2% both measures of weight distribution). These parameters altered significantly within the patient group and could form the basis of suitable measures of group performance in future studies designed to compare different treatment strategies for the hemiplegic patient.

University of Strathclyde
Bioengineering Unit

COLLECTION AND ANALYSIS OF PROSTHETIC LOAD DATA DURING OUTDOOR ACTIVITIES

Thesis submitted for the Degree of
MSc by Instruction
by
Karen Wendy Tilford

April 1985

ABSTRACT

Until a few years ago, prosthetic loading data from pylon transducer systems were collected using stationary measuring equipment, which restricted the amputee to the confines of the laboratory. To enable data to be collected from outside, with the amputee walking on different surfaces and gradients, a portable load measuring system was designed at the University of Strathclyde. This was later modified to increase the system reliablility.

Although some data had been collected, it was necessary to acquire more data using the modified equipment and with new analysis programs eliminating discrepancies present in the original computer routines, so that the effect of terrain and gradient could be assessed and the existing design standards evaluated.

This thesis describes in detail the procedure used to collect and analyse data from ten patients, and the development of the new data processing programs. The load measuring system, portable cassette recording system and playback unit are described briefly. The test route was chosen to include as many terrains and gradients as necessary to obtain a realistic picture of amputees outdoor activities.

The results of the tests are exhibited and conclusions drawn on the effects of terrain and gradient on the load patterns of amputee gait. The results are also compared with the present design standards for prosthetic limbs.

SIX PHASES OF A PROJECT

1. ENTHUSIASM
2. DISILLUSIONMENT
3. PANIC
4. SEARCH FOR THE GUILTY
5. PUNISHMENT OF THE INNOCENT
6. PRAISE & HONORS
for the
NON-PARTICIPANTS

RUN WITH THE LEADER

Director of Biomechanics Research

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Calender of scientific events

1986

October 3 - 6, 1986
O'Hare Hilton, Chicago, Illinois. Conference on Coaches Education.

October 3-6, 1986
Athens, Greece, "Third Intern. Course on Physiological Chemistry of Exercise and Training" (c/o Dr. J. Poortmans, ULB, ISEPK, Chimie Physiologique, 28 Av. Paul Héger, B-1050 Bruxelles, Belgique).

October 13-15, 1986
Bordeaux, France. "Biomat 86" University of Bordeaux II. Blood-Materials Interactions.

October 17-18, 1986
Bruges, Belgium. The Fifth Congress of Sports Medicine of the A.Z. St. Jan. V.Z.W. Brucosport, Lange Rei 17, B-8000 Bruges, Belgium.

October 21-24, 1986
Montreux, Switzerland. Ergodesign '86. The Evolution of the Electronic Workplace. Ergodesign '86 Press Service, PO Box 122, CH-1820 Montreux, Switzerland.

October 24, 1986
Nottingham, UK. Effects of Work Acitivites on the Spine. Professor E.N. Corlett, Department of Production Engineering and Production Management, University Park, Nottingham NG7 2RD, UK.

November 21, 1986
London, UK. Society for Back Pain Research. Mrs J. Reynolds, 309 Bawtry Rd, Doncaster DN4 7PA, UK.

October 31 - November 3, 1986
Nice, France. 3ème Symposium Internation de Biologie de l'Excercie et de l'Entraînement Physique. Hôtel PLAZA, Nice, France.

November 24-27, 1986
Université Libre de Bruxelles, Brussels, "Adapted physical activity for disabled persons". Contact: Mrs. M. Plash, Université Libre de Bruxelles, ISEPK (CP168), 28 Av. P. Heger, B-1050 Bruxelles, Belgium.

1987

January 29 - 31, 1987
113 Memorial Gymnasium, Virginia Tech Blacksburg, VA 24061, USA. Southeast Region Annual Meeting American College of Sports Medicine Charleston, SC. Contact: Ronald Bos.

April 6-10
Swansea, UK. Ergonomics Society 1987 Annual Conference. Dr. E. Megaw, Department of Engineering Production, University of Birmingham, Birmingham, UK

April 13 - 17, 1987
Albert Dock, Liverpool - England. First World Congress of Science and Football. Congress Secretariat Science and Football: Department of Sport and Recreation Studies Liverpool Polytechnic Byrom Street, Liverpool L3 3AF England.

May 23, 1987
Göteborg, Sweden. Centre for Biomechanics. Chalmers University of Technology. 1987 Biomechanics Seminar.

May 25 - 30, 1987
Sorrento, Italy. 8th International Congress of Electromyography and Related Clinical Neurphysiology. Organizing Secretariat: VIII International Congress of EMG and Related Clinical Neurophysiology, Cattedra di Neurofisiopatolagia UU Facoltà di Medicina e Chirurgia, Via S. Pansini 5, 80131 Napoli, Italy.

June 26 - 18, 1987
Warsaw, Poland. Ist International Symposium on computer simulation in Biomechanics.

June 9 - 12, 1987
Halifax Sheraton, Halifax, Nova Scotia. 13th Canadian Medical and Biological Engineering Conference. CMBEC-13-CCGB secretariat: The Nova Scotia Association of Health Organizations, 5614 Fenwick Street, Halifax, Nova Scotia B3G 1P9.

June 14 - 17, 1987
Hyatt Regency Hotel, Cincinnati, Ohio. 1987 Biomechanics Symposium.

June 28 - July 1, 1987
Trondheim, Norway. VIIth Nordic Meeting on Medical and Biological Engineering, A. Bye, Kursavdelingen - The Norwegian Institute of Technology, N-7034 Trondheim - Nth, Norway.

June 29 - July 3, 1987
Xth International Congress of Biomechanics, Vrije Universiteit Amsterdam, Amsterdam, the Netherlands.

July 6 - 10, 1987
International Seminar on Archery, Vrije Universiteit Brussel - Experimental Anatomy; Under the auspices of Olympic Solidarity and Workinggroup Biomechanics of Sport (ISB-ICSSPE), Brussels, Information: Prof. Dr. J.P. Clarys, Belgium

September 16 - 17, 1987
University of Leeds. European Conference Biomechanics in Sport. Contact: Paul Wright, Conference Department C349 The Institution of Mechanical Engineers 1 Birdcage Walk, Westminster London SW1H 9JJ, Tel: 01-222 7899 Extn 237, Telex: 917944

September 28 - October 2, 1987
Athens, Greece, "Int. Seminar on Ergometry" (c/o Prof. Dr. V. Klissouras, Univ. of Athens, Dept. of Phys. Educ. & Sport Science, 41 Olgas Street, Dafne 17237, Athens, Greece)

1988

May 29 - June 3, 1988
Metro Toronto Convention Centre, Toronto, Ontario, Canada. The International Conference on Exercise, Fitness and Health. Contact: Ontario Group Fitness Office, 1220 Sheppard Avenue East, Toronto, Ontario, Canada M 2K 2XI.

September 11-15, 1988
Seoul, Korea, "1988 Olypic 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, Korea).

1990

January 28 - February 2, 1990
Auckland, New Zealand. The IX Commonwealth and International Conference on Physical Education, Sport, Health, Dance, Recreation and Leisure.
Conference Convenor 1990, Ms Rosalie King, Auckland College of Education, Private Bag, Symonds St., Auckland, New Zealand.

ISB Membership news
Changes in address

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   S-21126 MALMÖ
   SWEDEN

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3. STACOFF ALEX
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   8003 ZURICH
   SWITZERLAND

4. Dr. C.L. VAUGHAN
   Professor of Bioengineering
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IMPORTANT NOTICE: CALL FOR NOMINEES

Under the election procedures adopted in 1981, elections of Executive Council members and President Elect take place every two years and are coordinated by the Past President of the International Society of Biomechanics. All active members are encouraged to submit names of possible nominees for the Ecexutive Council and for President Elect to the Past President prior to February 1, 1987.

The general guidelines for such nominations should be:

(1) **Internationality** (It is wise to have a Council that represents many different countries and doesn't have too many members from the same country).

(2) **Fields of Interest** (It would be wise to have a Council where the fields of interest of our Society are represented. Such fiels are, in alphabetical order, Locomotion Biomechanics, Material, Motor Control, Occupational Biomechanics, Orthopaedic Biomechanics and Sport Biomechanics).

(3) **Scientific Quality** (It would be wise to have a Council where the Council members are acknowledged with respect to their scientific quality).

(4) **Organizational Qualities** (Since most of the work of the Council is connected with leading the Society in organizing many different things, these qualities are of great importance).

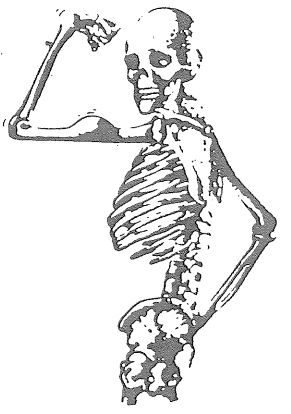
Potential nominees should be contacted prior to submission of the name to ensure that the member being nominated is willing to serve if elected.

A slate of official nominees will be developed from the list of names submitted, including those individuals who are currently members of the Executive Council and are eligible for re-election. (Each Council member's term is for two years with the possibility of being re-elected twice.) The official mail ballot will be sent to all active members some time during the Spring of 1987.

Voting will be conducted to select a President Elect and ten members of the Executive Council.

Please send names of potential nominees to:

Benno M. Nigg, Dr. sc. nat
Past President ISB
Biomechanics Laboratory
The University of Calgary
2500 University Drive N.W.
Calgary, Alberta T2N 1N4



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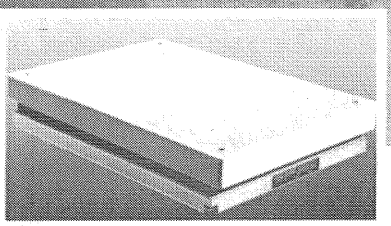

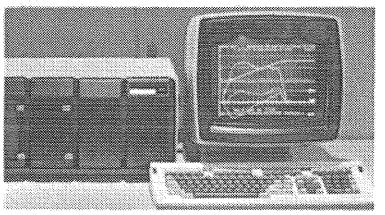

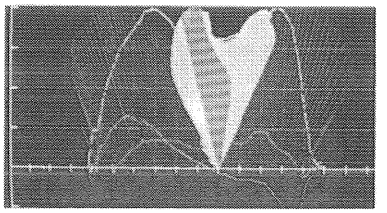

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