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PRINCIPAL INVESTIGATOR: Irene S. McClay, Ph.D.

CONTRACTING ORGANIZATION: University of Delaware
Newark, Delaware 19716

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Irene S. McClay, Ph.D.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
University of Delaware
Newark, Delaware 19716

E-Mail: McClay@udel.edu

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The overall aim of this research is to gain insight into the etiology of tibial stress fractures. Three dimensional motion analysis data along with structural data will be collected from 400 subjects (200 at each site) over a 3-year period. 30 of the subjects will have sustained a tibial stress fracture prior to the study and the other 370 will have not. Subjects will be recruited primarily from track teams, running clubs, and physicians local to the University of Delaware and University of Massachusetts. Within this Annual Report, information concerning adherence to work objectives, preliminary results with respect to the proposed hypotheses, and reportable outcomes are presented for the first 12 months of the investigation. Overall, we have adhered to most work objectives and have proposed plans for rectifying any discrepancies. The preliminary analysis of the data demonstrates encouraging results and support of most hypotheses. Future work will provide more subjects who have suffered tibial stress fractures.

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INTRODUCTION

Stress fractures can be extremely costly to the military in terms of both time and medical expenses. The tibia is a common site for such injuries and has been most often associated with running, an activity common to all military training. Stress fractures are among the top 5 cited to account for 50% of all injuries sustained by runners (Kowal, 1980; Reinker et al., 1979; Jones et al., 1983; James et al., 1978; Clement et al., 1981; Pagliano et al., 1980). They are among the most serious of running-related overuse injuries as they take long to heal and if untreated, can progress to a macrofracture. Females, a growing military contingency, appear to be particularly susceptible, as it has been noted that they are twice as likely to experience a stress fracture than their male counterparts (Brudvig et al, 1983; Pester & Smith, 1992; Reinker et al, 1979). The tibia is a common site for such injuries and has been most often associated with running. Structural and biomechanical factors have been suggested in the cause of stress fractures. However, these mechanisms are not well understood. Therefore, the purposes of this study are 1) to compare the structure mechanics of runners who have sustained a tibial stress fracture to those who have not, 2) to gain an understanding of which combination of factors (structural and/or biomechanical) are predictive of tibial stress fractures, and 3) to assess whether mechanics are altered following a tibial stress fracture. Once the parameters associated with stress fractures are identified, future work will focus on formation and testing of a simple screening tool to facilitate identification of those at risk.

The study began on September 1, 2001 after funding was received from the Department of Defense and has been under investigation for 12 months. This Annual Report will focus on preliminary results after the first year of the study.

BODY

Summary of Methodology

The overall aim of this research is to gain insight into the etiology of tibial stress fractures. Three dimensional motion analysis data along with structural data will be collected from 400 subjects (200 at each site) over a 3-year period. 30 of the subjects will have sustained a tibial stress fracture prior to the study and the other 370 will have not. Subjects will be recruited primarily from track teams, running clubs, and physicians local to the University of Delaware and University of Massachusetts. All subjects will be females between the ages of 18 and 45 and will be free of lower extremity injury at the time of testing. Lower extremity kinematics and kinetics will be collected during running. In addition, radiographs of both tibia will be taken as well as clinical measures of lower extremity alignment. Subjects will then report their exposure data (mileage, intensity, terrain) as well as any injuries they have sustained each month via a custom developed webpage which will serve as a database for this information. If a subject reports a tibial stress fracture/reaction, the site coordinator will be notified automatically

and the subject will be asked to return for a second running analysis once the fracture has healed and they are cleared to run by their physician. The structural and biomechanical factors leading up to a tibial stress fracture will be assessed. In addition, comparisons will be made of mechanics before and after the stress fracture to determine whether subjects revert back to their pre-injury mechanics.

Statement of Work

Between the two data collection sites, the following objectives were outlined in the approved Statement of Work for the first year. These objectives included:

1. Recruitment of 50 subjects per site.
2. Collection and reduction of kinematic, kinetic, and structural data (radiographs, and lower quarter evaluations).
3. Design, development and refinement of web page database to store and retrieve data from both sites.
4. Begin follow-up procedures on subjects.

Adherence to Work Objectives

1) Recruitment of Subjects

To date, data on 20 subjects have been collected at the University of Delaware and 23 subjects have been collected at the University of Massachusetts. Several local coaches and track teams have been recruited to recruit subjects and establish relationships for injury tracking. Additional contacts will continue to be made to recruit the necessary subjects.

Although these numbers do not reflect what was proposed, several circumstances exist to explain the discrepancy. We were notified of our award in September of 1999 and were hoping to begin work on the web page database in the spring of 2000. However, the funds did not become available until July 2000. Therefore, work on the database did not begin until September, 2000. The first subject was collected in December, 2000 so we missed collecting the fall cross country teams. The bulk of the remainder subjects being collected in Jan-Feb, 2001. We believe that we will have the remaining 30 subjects at each site collected by Dec. 2001, putting us 3 months behind on our schedule. All universities having women's track and cross country teams within a 60 mile radius of each site (16 for the University of Delaware and 8 for the University of Massachusetts) have been identified (Appendix A) and these will continue to be the primary recruitment locations.

2) Collection of Data

All kinematic, kinetic, and structural data have been collected for the 43 subjects. Preliminary results will be presented in the Reportable Outcomes section. All radiographs have been digitized and a custom program has been developed to determine the area moment of inertia parameters needed for the analysis.

Local physicians have been contacted and a working relationship has been established at Papastavros' Associated Medical Imaging in Newark, DE and University

Health Services Radiology Department in Amherst, MA for the purpose of taking x-rays of each subject.

3) Development of Database

A web-based injury tracking and reporting system was to be developed and be ready for use by September 1, 2001. Within this program, subject injury and training history, monthly exposure, and monthly injuries are documented. It is then possible to compile all information into a database for statistical analysis. Furthermore, subjects are automatically sent a monthly e-mail reminder to login to the web site and record their monthly exposure and injury status. If any subject reports a stress injury/fracture of the lower extremity or any injury to the tibia, an e-mail notification is sent to the program coordinator.

The programmer who began the development of the database was unable to implement the automatic function of reminding the subjects to log in each month and notifying the site coordinator of any potential tibial stress fractures that were reported. He worked on this for months and then left the University of Delaware to take a position elsewhere. We therefore had to hire a new programmer who has recently produced a fully functioning web-based program that meets all of our needs and specifications. Examples of the user interface are found in Appendix B.

4) Follow-up procedures

Since the web-based injury tracking and reporting system has not been implemented as of yet, follow-up procedures have been conducted via telephone and e-mail for the 43 subjects. All subjects have been tracking their monthly running exposure and injuries since their initial visit and these data will be input into the database.

KEY RESEARCH ACCOMPLISHMENTS

Data collection and analysis of this 5-year project is still in the early stages. As defined by the Technical Reporting Requirements guidelines, there are no Key Research Accomplishments to report, nor were any expected at this stage of the project.

REPORTABLE OUTCOMES

Preliminary Data Analysis

A summary of all of the subjects as well as a small group of subjects who have sustained a tibial stress fracture prior to entering the study will be presented.

Of the 43 subjects who have participated in this investigation, 5 have had previous tibial stress fractures (**PrTSF**). It was hypothesized that these subjects, in comparison to the non-injured limb and as compared to runners who have never sustained a tibial stress fracture, would exhibit:

1. greater vertical loading rates
2. greater peak vertical ground reaction forces (GRF)
3. greater peak positive tibial acceleration
4. greater stiffness
5. greater tibial varum
6. decreased tibial area moment of inertia
7. decreased ankle dorsiflexion excursion
8. decreased knee flexion excursion

With the relatively small number of participants who have suffered previous tibial stress fractures, statistical analyses of the preliminary results have not been performed. Results for each of these variables will be discussed individually with respect to trends observed in the data. A summary of results for the respective hypotheses is presented in Table 1.

TABLE 1. Mean Scores for Preliminary Results of Selected Hypotheses

	Uninjured Group	PrTSF Group	
Variable	Both Limbs	Injured Limb	Non-injured Limb
Vertical Loading Rates	108.81	110.85	96.46
Peak GRF	2.52	2.54	2.59
Peak Positive Tibial Acceleration	7.52	8.18	6.27
Stiffness	8.70	9.68	10.58
Tibia Varum	5.25	5.29	4.00
Moment of Inertia (M/L level 1)	21748.79	15894.06	19821.13
Moment of Inertia (M/L level 2)	20322.50	18453.61	21958.94
Moment of Inertia (A/P level 1)	12874.78	11319.31	13174.76
Moment of Inertia (A/P level 2)	13297.36	12550.97	14662.46

Vertical Loading Rates

Analysis of vertical GRF data (Fig 1) supports the hypothesis that the injured limb of the PrTSF group exhibited a greater rate of loading as compared to the non-injured limb. No differences can be observed as compared to the Uninjured group.

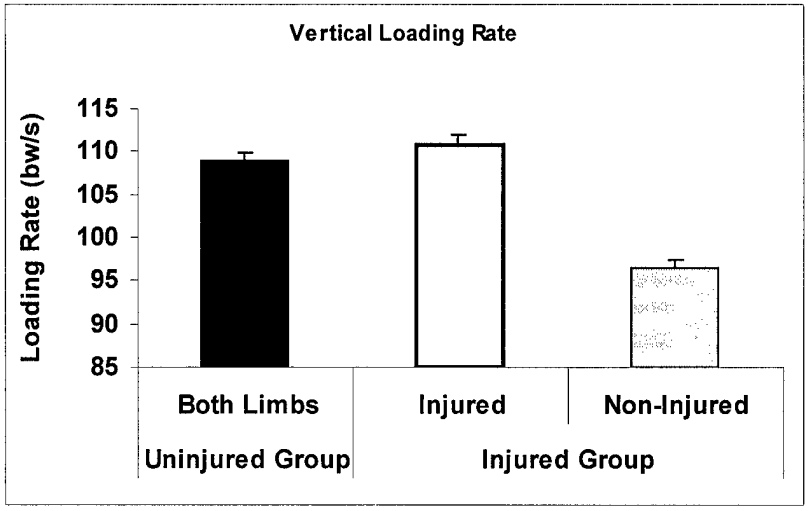

Figure 1. Vertical loading rate for the Uninjured and Previous Tibial Stress Fracture Groups.

Peak vertical ground reaction forces

In partial support of the hypothesis, the injured limb of the PrTSF exhibited a reduced peak vertical ground reaction forces (GRF) as compared to the non-injured limb but greater peak vertical GRF as compared to the Uninjured group (Fig 2).

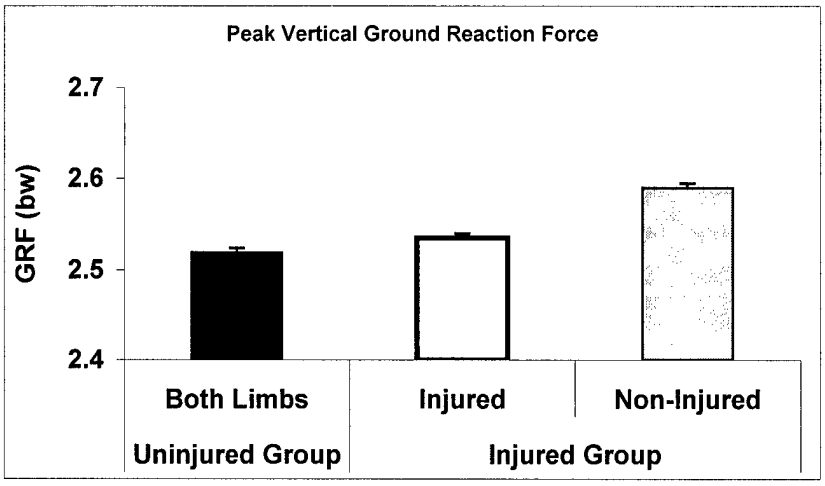

Figure 2. Peak vertical ground reaction force for the Uninjured and Previous Tibial Stress Fracture Groups.

Peak positive tibial acceleration

Analysis of peak positive tibial acceleration (Fig 3) supports the hypothesis that the injured limb of the PrTSF group exhibited greater acceleration at heel contact as compared to the non-injured limb and as compared to the Uninjured group

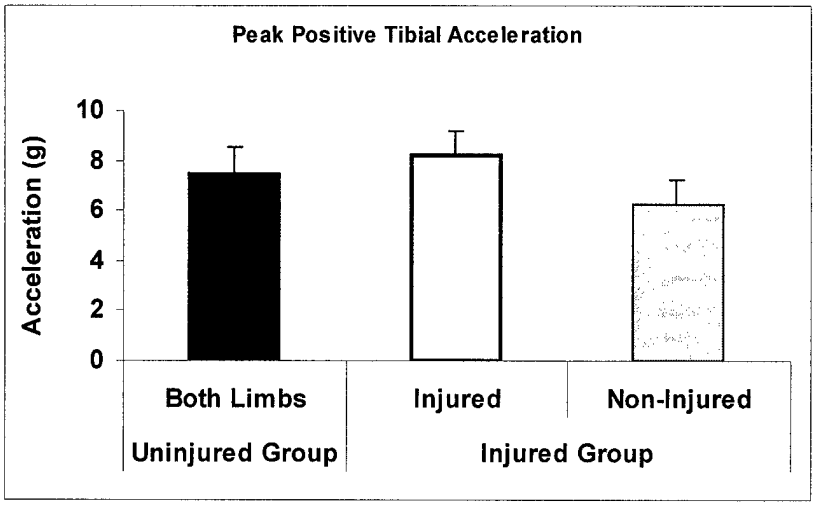

Figure 3. Peak positive tibial acceleration force for the Uninjured and Previous Tibial Stress Fracture Groups.

Stiffness

In partial support of the hypothesis, the injured limb of the PrTSF group exhibited less stiffness as compared to the non-injured limb but greater stiffness as compared to the Uninjured group (Fig 4).

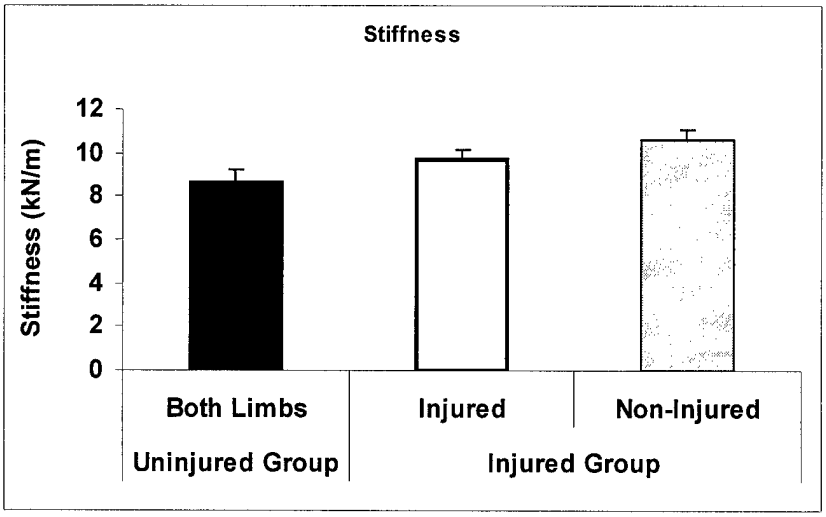

Figure 4. Stiffness for the Uninjured and Previous Tibial Stress Fracture Groups.

Tibial varum

Analysis of tibial alignment (Fig 5) supports the hypothesis that the injured limb of the PrTSF group exhibited greater tibial varum as compared to the non-injured limb. However, no differences were observed as compared to the Uninjured group

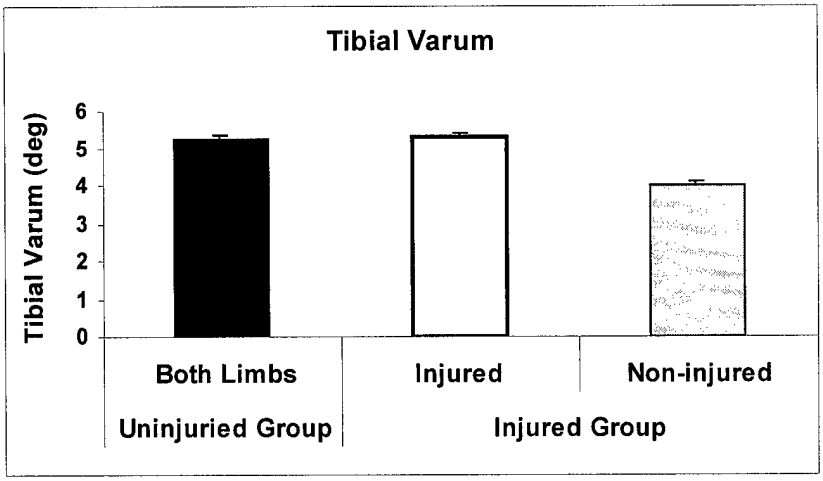

Figure 5. Tibial Varum for the Uninjured and Previous Tibial Stress Fracture Groups.

Decreased tibial area moment of inertia

The moment of inertia was calculated at two levels and for both the medial/lateral and anterior/posterior aspects of the tibia as described by Milgrom et al. (1989). It was hypothesized that the injured limb of the PrTSF group would exhibit a reduced moment of inertia as compared to the non-injured limb and Uninjured group. This hypothesis is supported in the preliminary analysis of the data for both views and for both tibial levels (Fig 6,7,8, & 9).

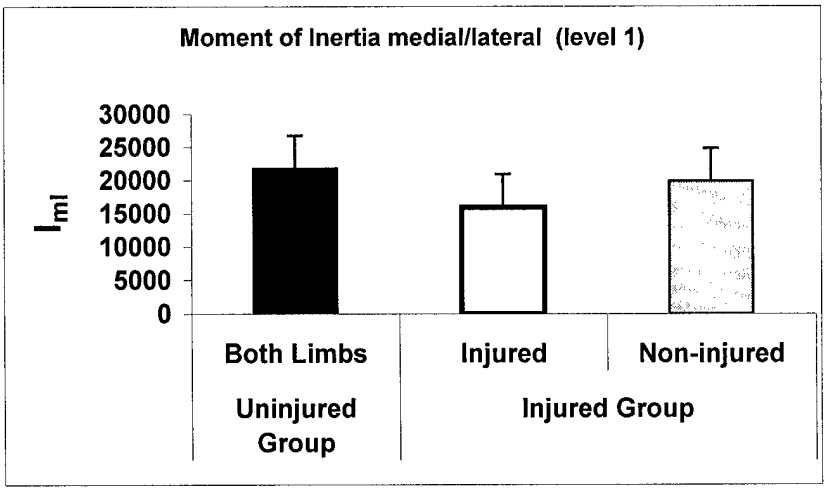

Figure 6. Level 1 Medial/Lateral Moment of Inertia for the Uninjured and Previous Tibial Stress Fracture Groups.

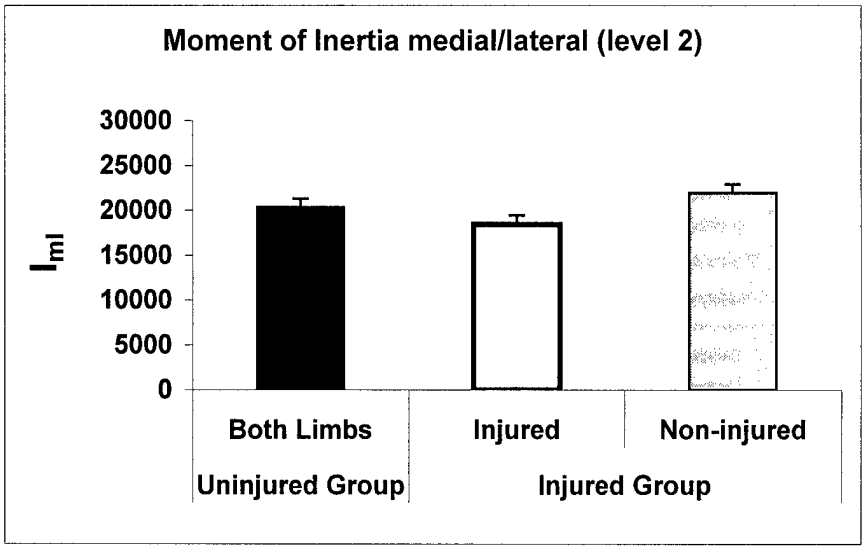

Figure 7. Level 2 Medial/Lateral Moment of Inertia for the Uninjured and Previous Tibial Stress Fracture Groups.

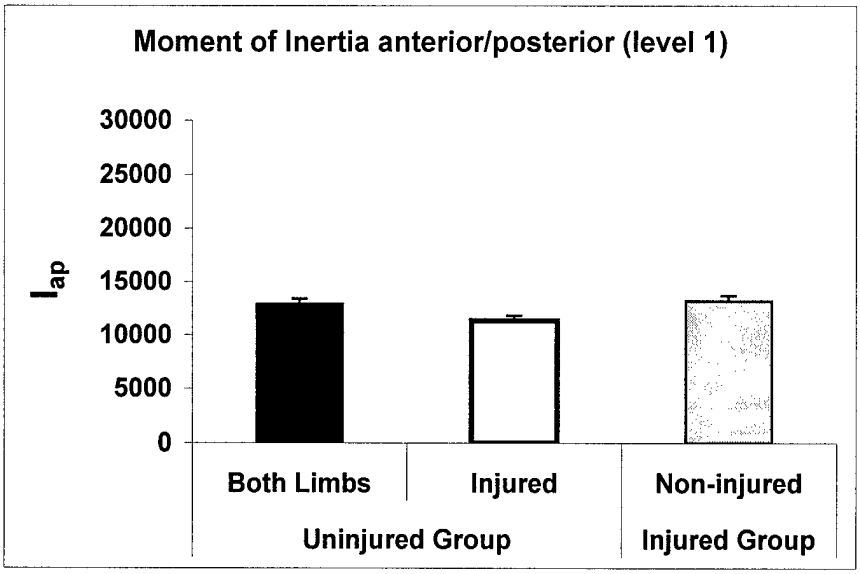

Figure 8. Level 1 Anterior/Posterior Moment of Inertia for the Uninjured and Previous Tibial Stress Fracture Groups.

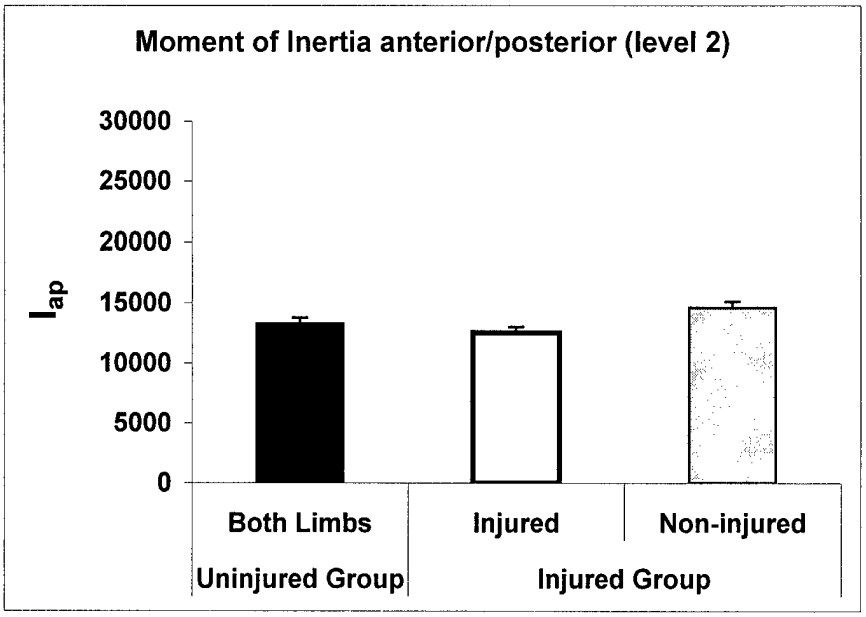

Figure 9. Level 2 Anterior/Posterior Moment of Inertia for the Uninjured and Previous Tibial Stress Fracture Groups.

Decreased ankle dorsiflexion excursion

It was hypothesized that the injured limb of the PrTSF group would exhibit decreased ankle dorsiflexion excursion during the first portion of stance (0-20%). Figure 10 demonstrates that this hypothesis was not supported by the preliminary analysis as the injured limb of the PrTSF subjects exhibited greater ankle plantarflexion excursion as compared to the non-injured limb and the Uninjured subjects (Fig 10)..

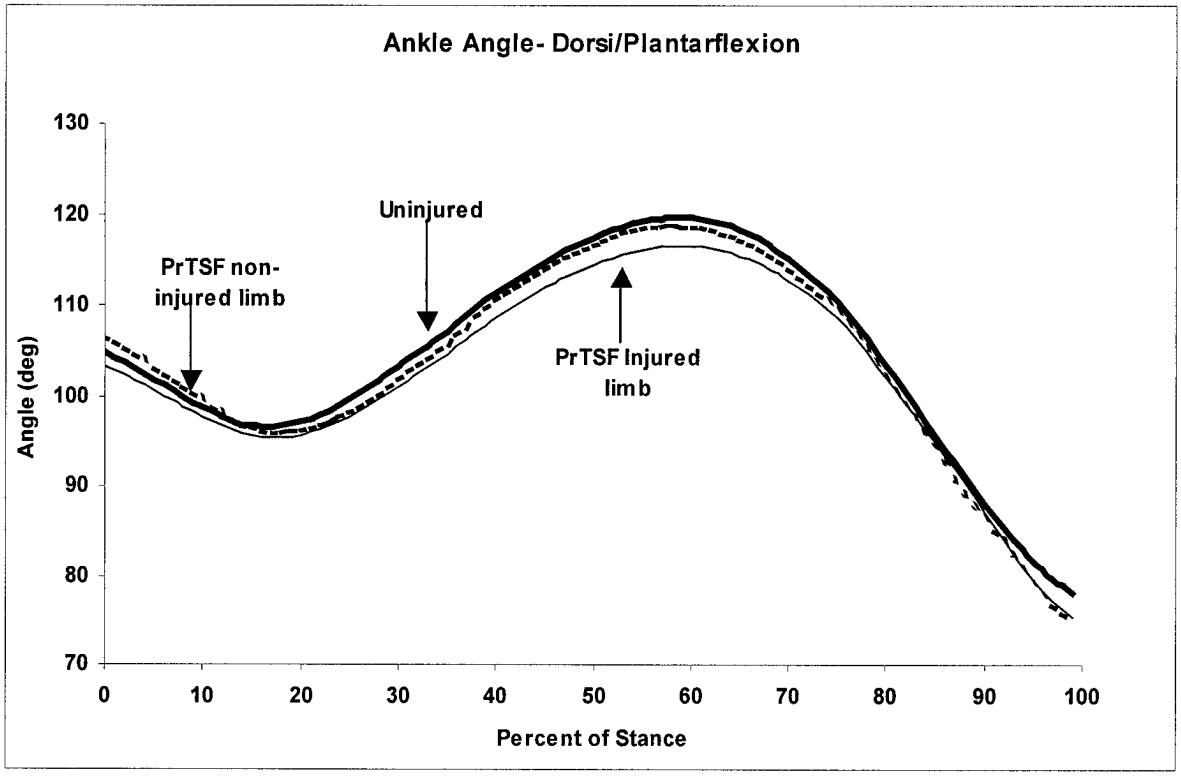

Fig 10. Ankle Angle During the Stance Phase of Gait for the Uninjured and Previous Tibial Stress Fracture Groups. Greater values represent ankle dorsiflexion.

Decreased knee flexion excursion

It was hypothesized that the injured limb of the PrTSF group would exhibit decreased knee flexion excursion during the first portion of stance (0-10%). This hypothesis was supported by the preliminary analysis as the injured limb of the PrTSF subjects exhibited greater knee flexion excursion as compared to the non-injured limb and the Uninjured subjects (Fig 11).

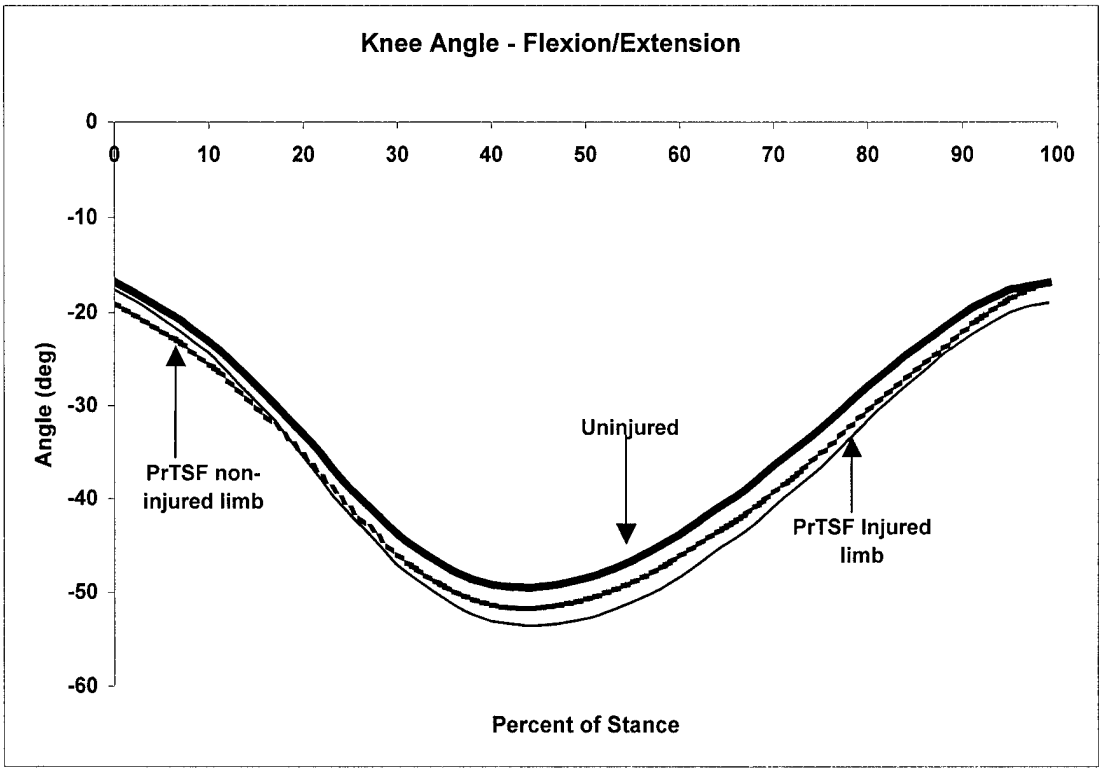

Fig 11. Knee Angle During the Stance Phase of Gait for the Uninjured and Previous Tibial Stress Fracture Groups. Positive values represent knee extension.

Publications

From data collected on the 43 subjects, one abstract has been submitted and was presented at the American Physical Therapists' Association Combined Sections Meeting in Boston, Massachusetts. The reference is provided below and the complete abstract is included in the Appendix C.

Multiple Lower Extremity Stress Fractures In A Division I Cross Country Runner: A Case Study. Pollard C.D., McClay I.S., Hamill J. 2001 APTA Combined Sections Meeting, Boston, Massachusetts.

Additional 3-D Lower Extremity Variables

The overall aim of this research is to gain insight into the etiology of tibial stress fractures using three dimensional motion analysis and structural data. 3-D data of all other lower extremity variables for the 43 subjects has been collected and are presented in Appendix C. The Motion Analysis equipment at each University are working properly as are the computer programs used for data analysis. The data presented in Appendix E are similar to previously reported data.

CONCLUSIONS

The overall aim of this research is to gain insight into the etiology of tibial stress fractures using 3-D motion analysis and structural data. Data from 400 subjects will be collected at the University of Delaware and University of Massachusetts (200 at each site) over a 3-year period. 30 of the subjects will have sustained a tibial stress fracture prior to the study and the other 370 will have not. The structural and biomechanical factors leading up to a tibial stress fracture will be assessed. In addition, comparisons will be made of mechanics before and after the stress fracture to determine whether subjects revert back to their pre-injury mechanics.

This Annual Report focused on the one-year status of this investigation. Four specific work objectives were approved and discussed with respect to adherence and methods to meet all objectives in a timely manner. We are confident that by December of 2001, we will be very close to achieving all work objectives.

To date, data on 43 subjects were collected and a preliminary analysis was performed. Overall, the primary hypotheses are supported by the data after subjective analysis. These are encouraging results. We are confident that additional data will provide valuable information regarding mechanics and etiology of tibial stress fractures.

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APPENDICES

Appendix A: Universities having women's track and cross country teams within a 60 mile radius of each site

Here is the list of (8) schools that match your search criteria. Click on a school name for information on everything from financial aid to admissions to campus life, or return to the search page to modify your search criteria.

School	State	Sports
Trinity College	CT	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
Amherst College	MA	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
Fitchburg State College	MA	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
Mount Holyoke College	MA	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
Smith College	MA	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
Westfield State College	MA	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
Worcester State College	MA	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
Keene State College	NH	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)

Here is the list of (16) schools that match your search criteria. Click on a school name for information on everything from financial aid to admissions to campus life, or return to the search page to modify your search criteria.

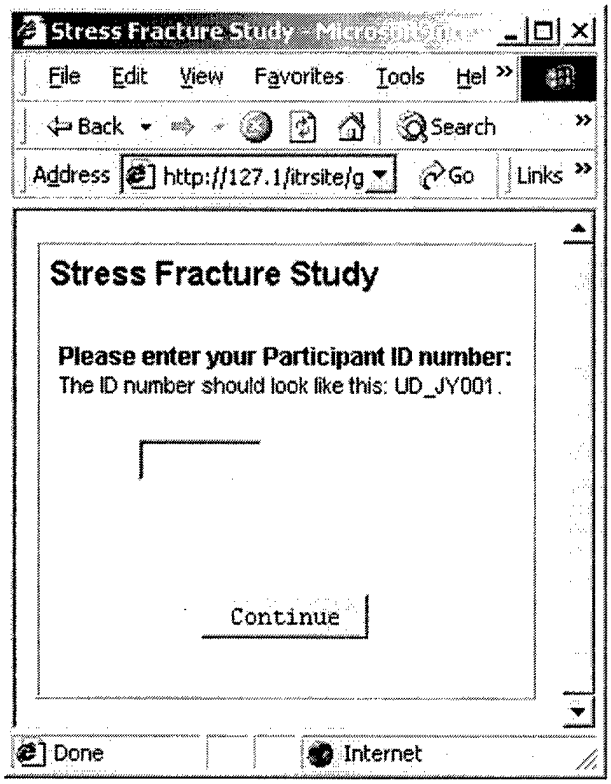
School	State	Sports
Delaware State University	DE	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
University of Delaware	DE	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
United States Naval Academy	MD	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
Albright College	PA	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
Delaware Valley College	PA	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
Franklin and Marshall College	PA	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
Haverford College	PA	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
La Salle University	PA	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
Lebanon Valley College	PA	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
Lincoln University	PA	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
Millersville University of Pennsylvania	PA	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
St. Joseph's University	PA	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
Swarthmore College	PA	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
Ursinus College	PA	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
Villanova University	PA	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)
West Chester University of Pennsylvania	PA	cross-country, track (indoor), track (outdoor), track and field (indoor), track and field (outdoor)

Appendix B: Web-based injury tracking and reporting system

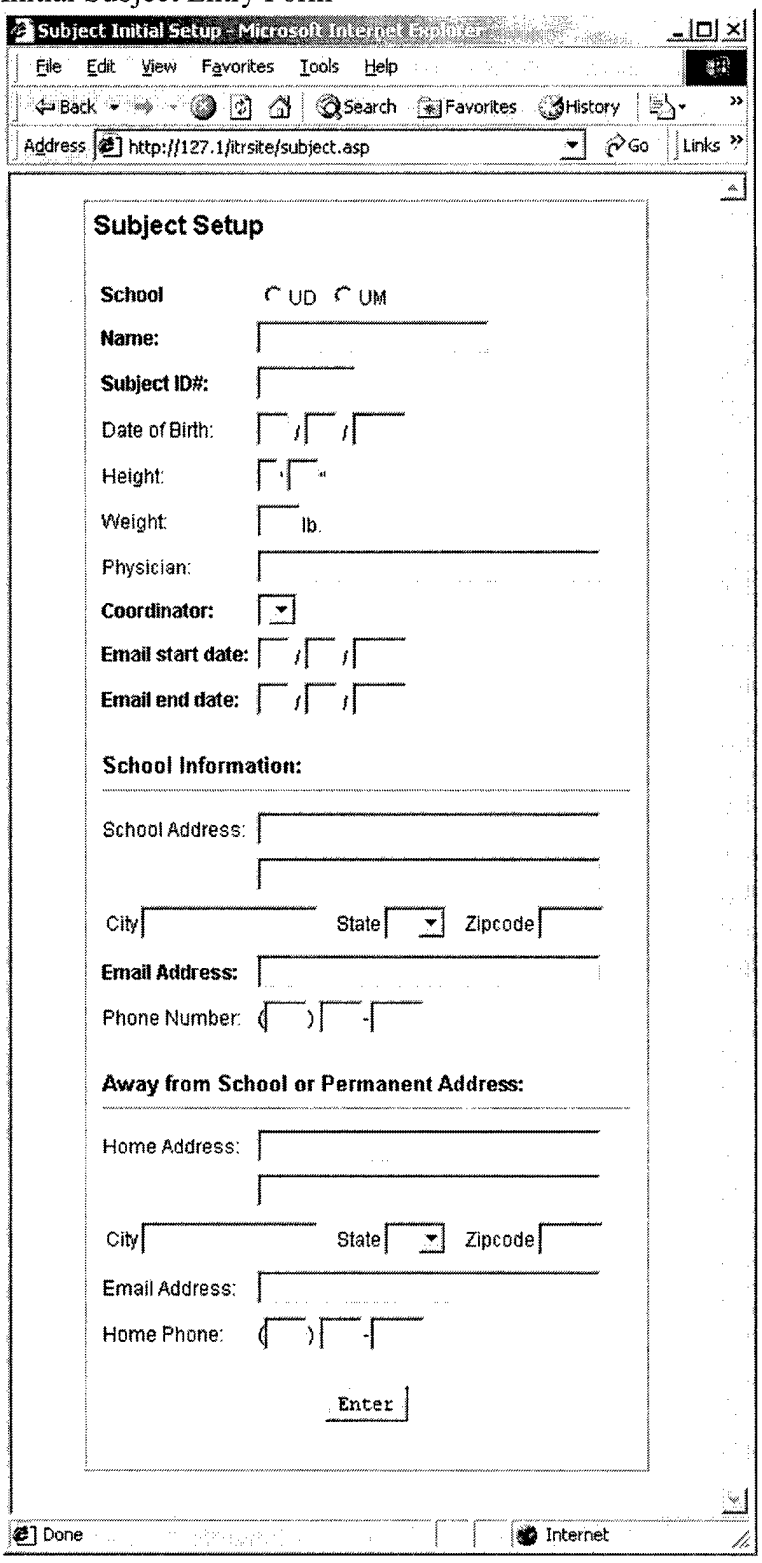
User Interface

This section specifies conceptual user interface as wire frame templates. Note that the templates are for illustration only and do not represent the look and feel of the final system.

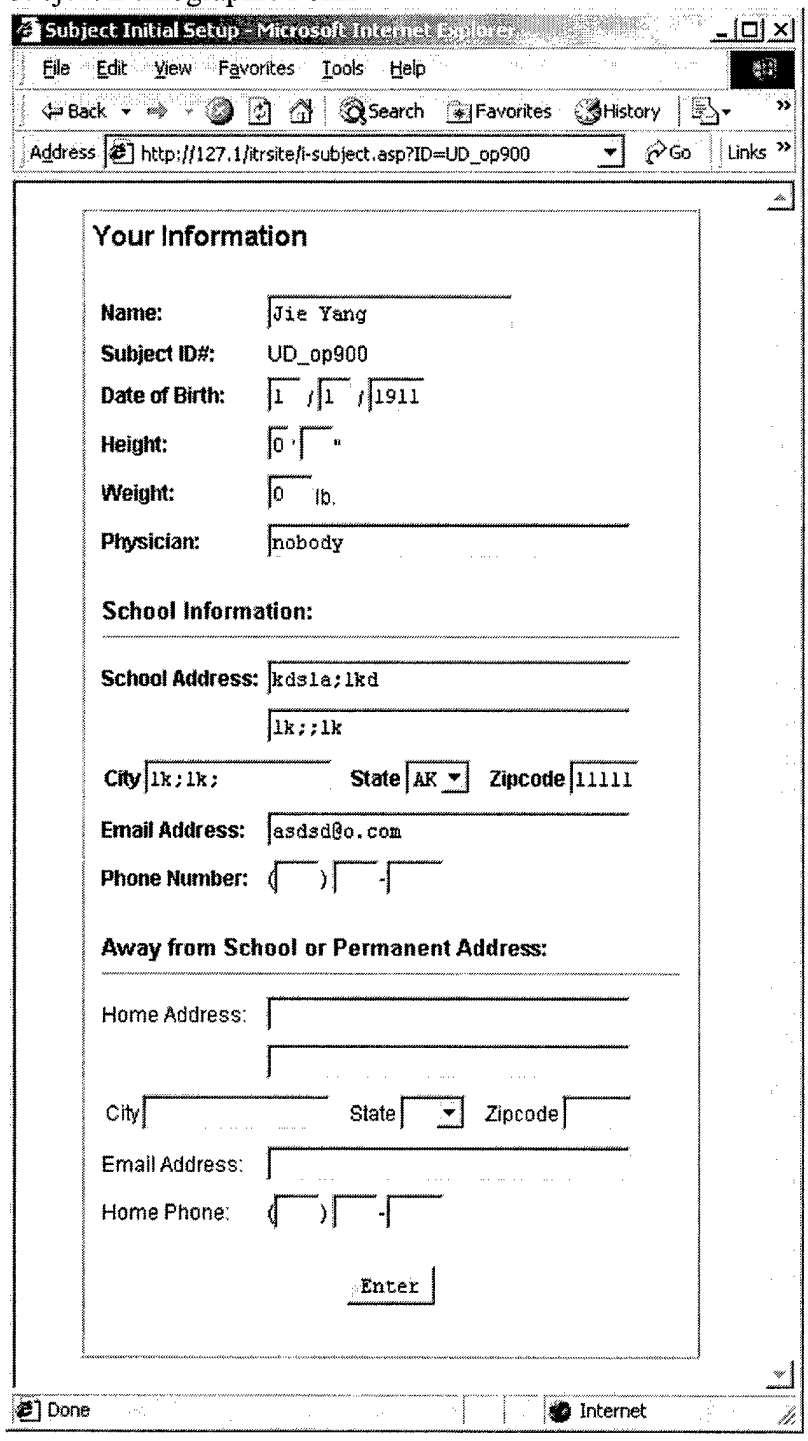
Subject ID Form



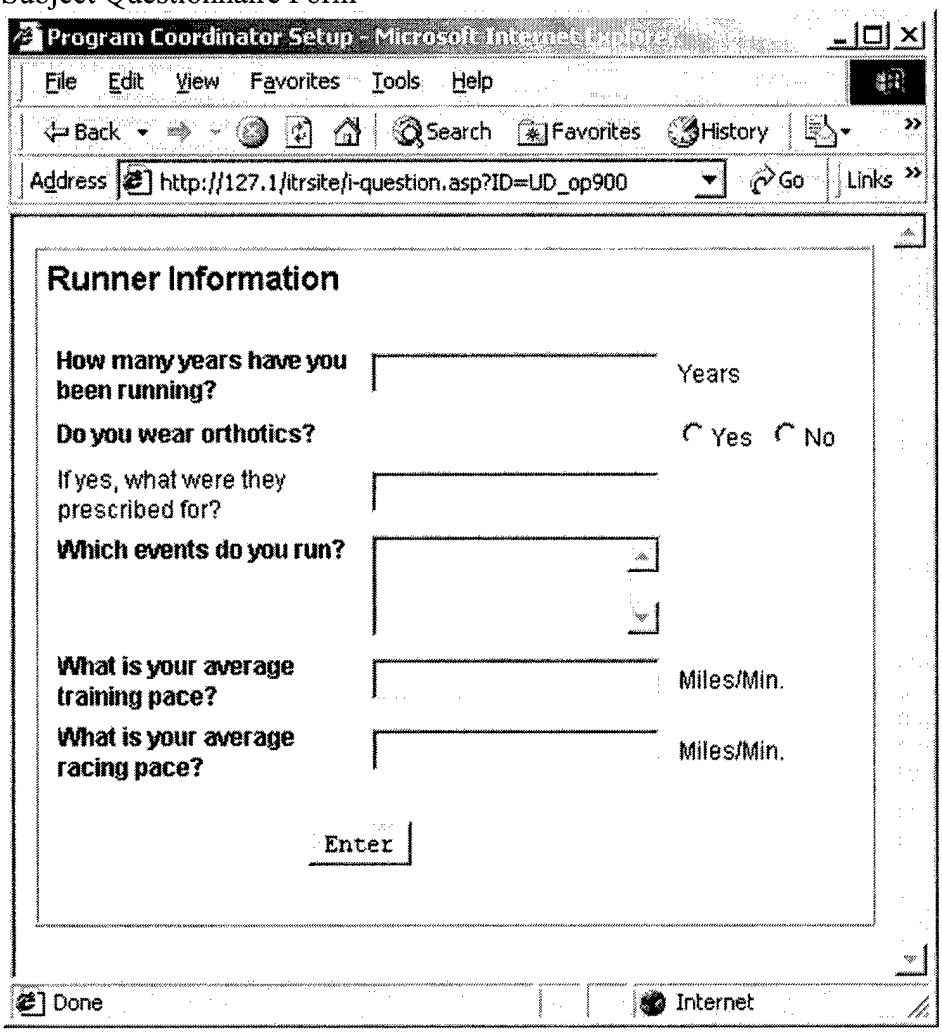
Initial Subject Entry Form



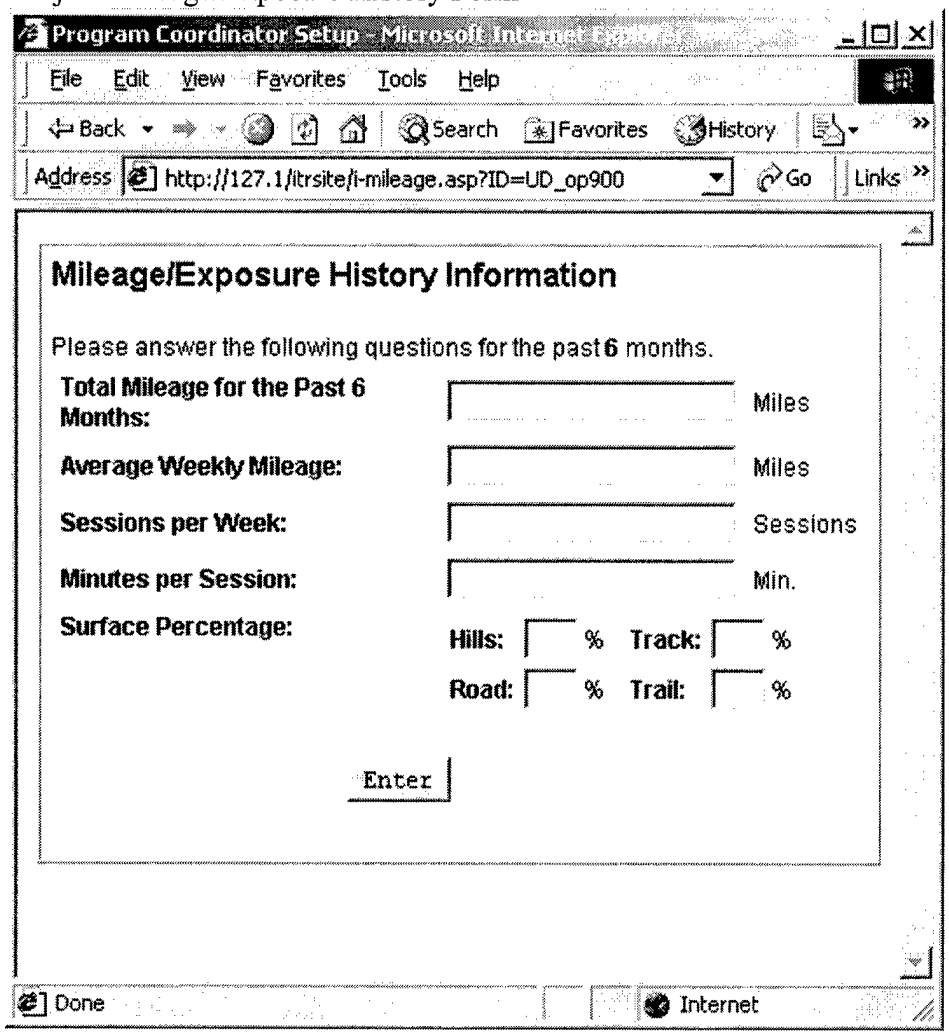
Subject Demographic Form



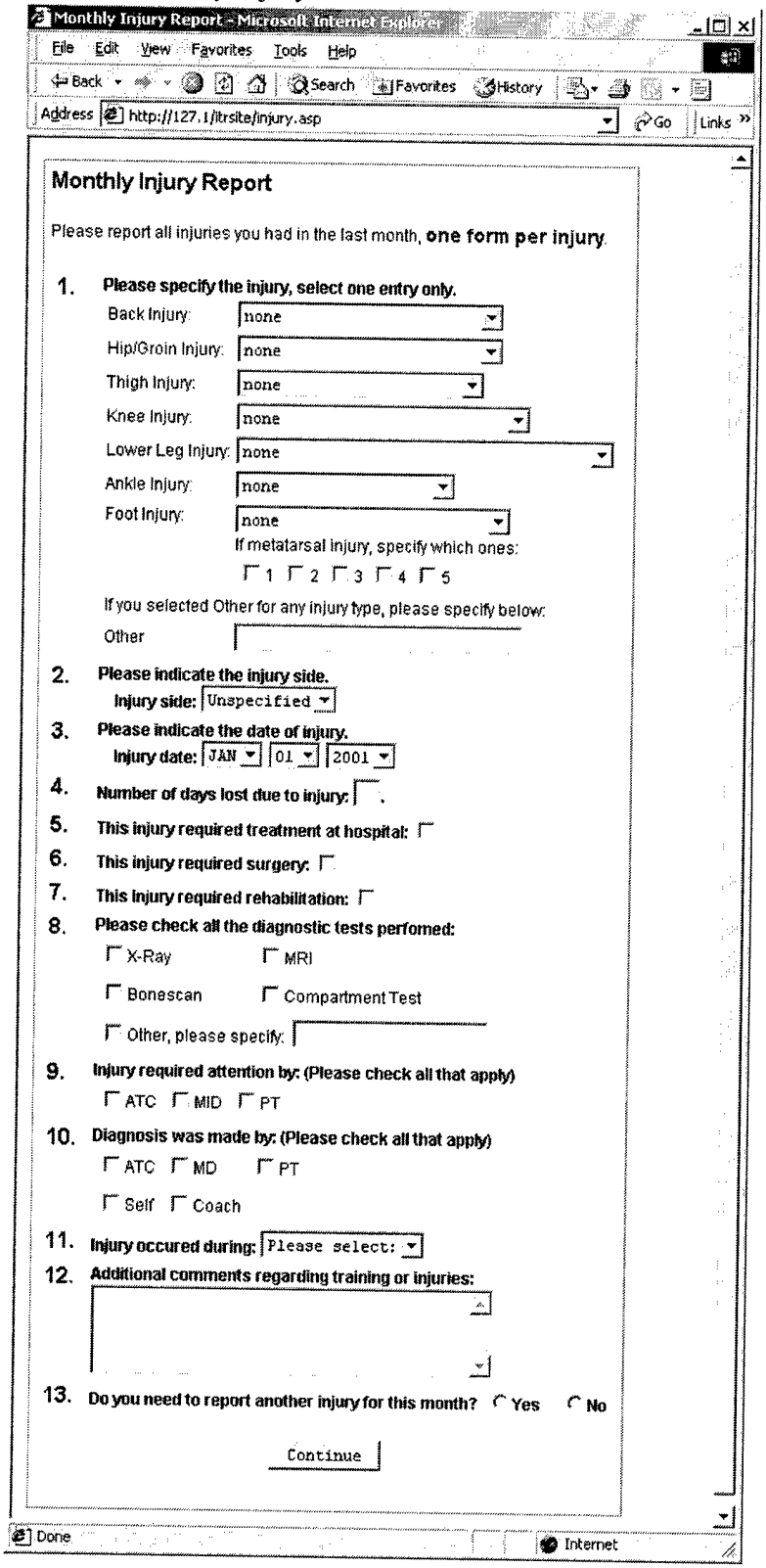
Subject Questionnaire Form



Subject Mileage/Exposure History Form



Subject Monthly Injury Form



Injury Alert

If a subject reports a stress injury/fracture of the lower extremity, or any injury to the tibia, an email notification is sent to responsible program coordinator. Included in the email is a link to the subject lookup page so that the recipient can click on the URL link to access the user information directly.

Appendix C: Abstract

MULTIPLE LOWER EXTREMITY STRESS FRACTURES IN A FEMALE DIVISION I CROSS COUNTRY RUNNER: A CASE STUDY. **Pollard C. D., McClay I. S., Hamill J. Biomechanics Laboratory, University of Massachusetts, Amherst, MA.**

Background and Purpose. A stress fracture in the high performance collegiate athlete presents a difficult problem. The tibia is the most common site of stress fractures in runners accounting for between 32-56% of total stress fractures reported. The purpose of this case report is to describe a case of multiple lower extremity stress fractures over time. **Case Description.** The patient is a 20-year-old female Division I collegiate cross-country runner who reported a history of five lower extremity stress fractures over the past three years. The stress fractures were located at bilateral tibias, bilateral first metatarsals, and the right third metatarsal. The right tibial stress fracture was diagnosed during the cross-country season, while the others were diagnosed during the off-season. The patient reported complying with the recommended rest period of 6-10 weeks following each stress fracture diagnosis. The patient has trained and competed in custom orthotics since recovery from the first stress fracture. The patient has been evaluated by a registered dietician and determined to have adequate nutrition and eating habits. The patient is eumenorrhoeic and had two separate DEXA bone density scans over the past two years that demonstrated normal bone density. Area moments of inertia were measured for the distal third of both tibias and were 30% lower than average values. Bilateral peak tibial accelerations were measured during running (3.70 m/s) and were also within normal range (5-8 g's). However, the right peak tibial acceleration was on the high end of normal values (8.3 g's). Upon a recent physical therapy evaluation, the patient presented with significant bilateral static genu varum and excessive bilateral static calcaneal eversion (right: rearfoot angle 18°, tibial varum 11°; left: rearfoot angle 15°, tibial varum 10°). Over the past three years, the patient has been followed by a sports medicine physician and has participated in numerous physical therapy treatment progressions. **Outcome.** Although this patient has attempted to do everything indicated to prevent the reoccurrence of a lower extremity stress fracture, she has not been successful. **Discussion.** It is thought that overuse injuries occur when tissues do not adapt normally to repetitive stress. There can be numerous underlying reasons that these tissues do not adapt normally and result in a stress fracture. Anatomic malalignment has been implicated in the etiology of stress fractures. Matheson et al. (1987) noted that varus malalignment (genu & tibial) was often present in athletes with stress fractures. This patient exhibits significant lower extremity malalignment. Bone structure is thought to contribute significantly to the overall risk of stress fractures. Milgrom et al. (1989) has suggested that stress fractures may occur in regions where high bending loads are found. This patient exhibits lower than average tibial area moments of inertia (resistance to bending). In an attempt to prevent future stress fractures, following her first stress fracture, this patient made multiple adaptations in her training, strengthening, and flexibility programs and implemented the use of orthotics. These adaptations did not result in the avoidance of further stress fractures. Even though this patient has followed all recommendations, she seems to have bilateral anatomic alignment and structural limitations that may not allow her tissues to tolerate the training demands of a Division I cross country runner.

References.

1. Matheson G. *et al., Am J Sports Med* 1987. 15:46-58.
2. Milgrom C. *et al., J Biomechanics* 1989. 22:1243-1248.

Appendix D: Group Data for 3-D Joint (Ankle, Knee, and Hip) Angle, Moment, Power, and Ground Reaction Force Data

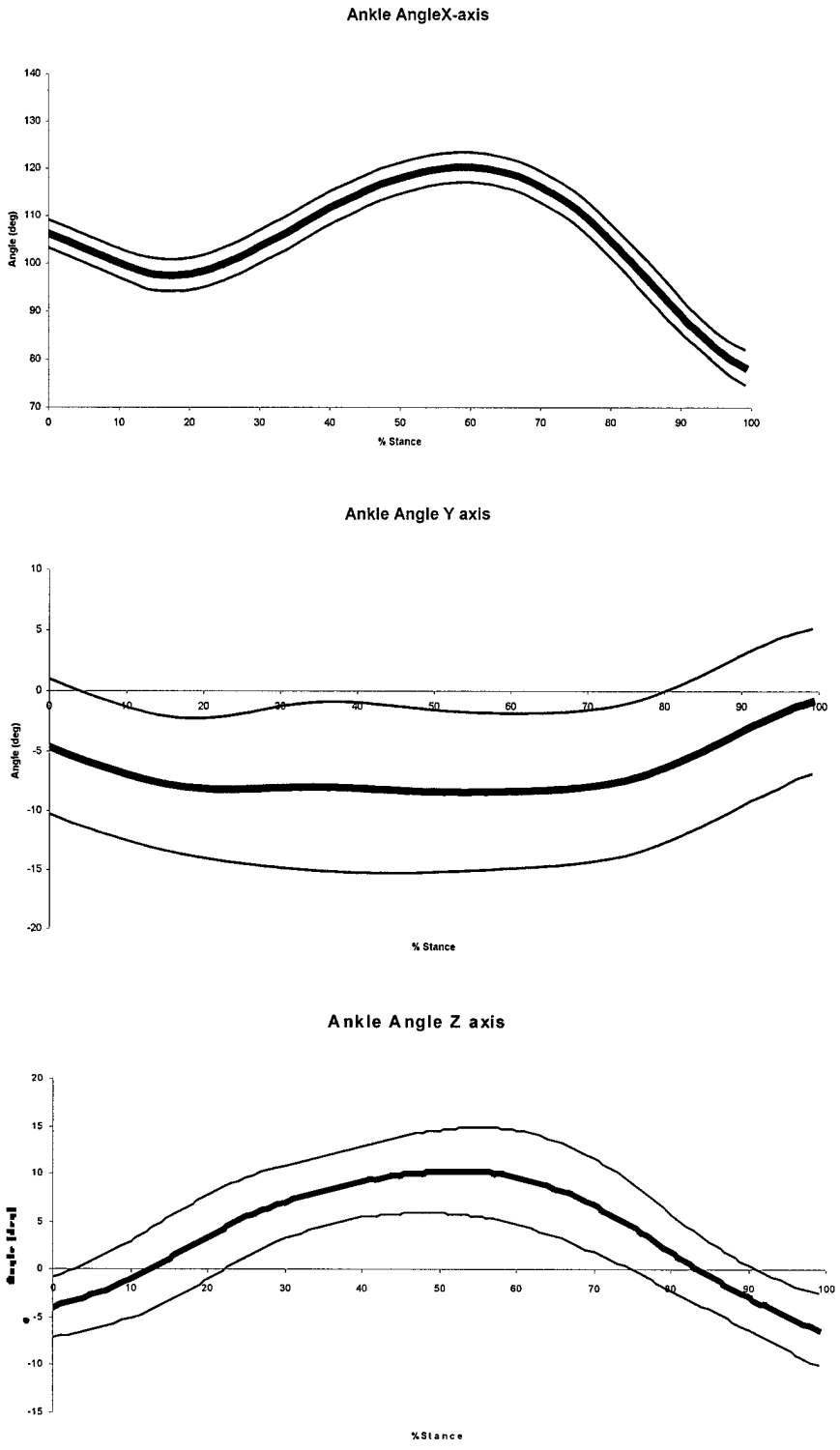


Figure 1. Ankle Angle in X (sagittal plane), Y (coronal plane), and Z (transverse plane) axes. Positive values indicate dorsiflexion (top), abduction (middle), and eversion (bottom).

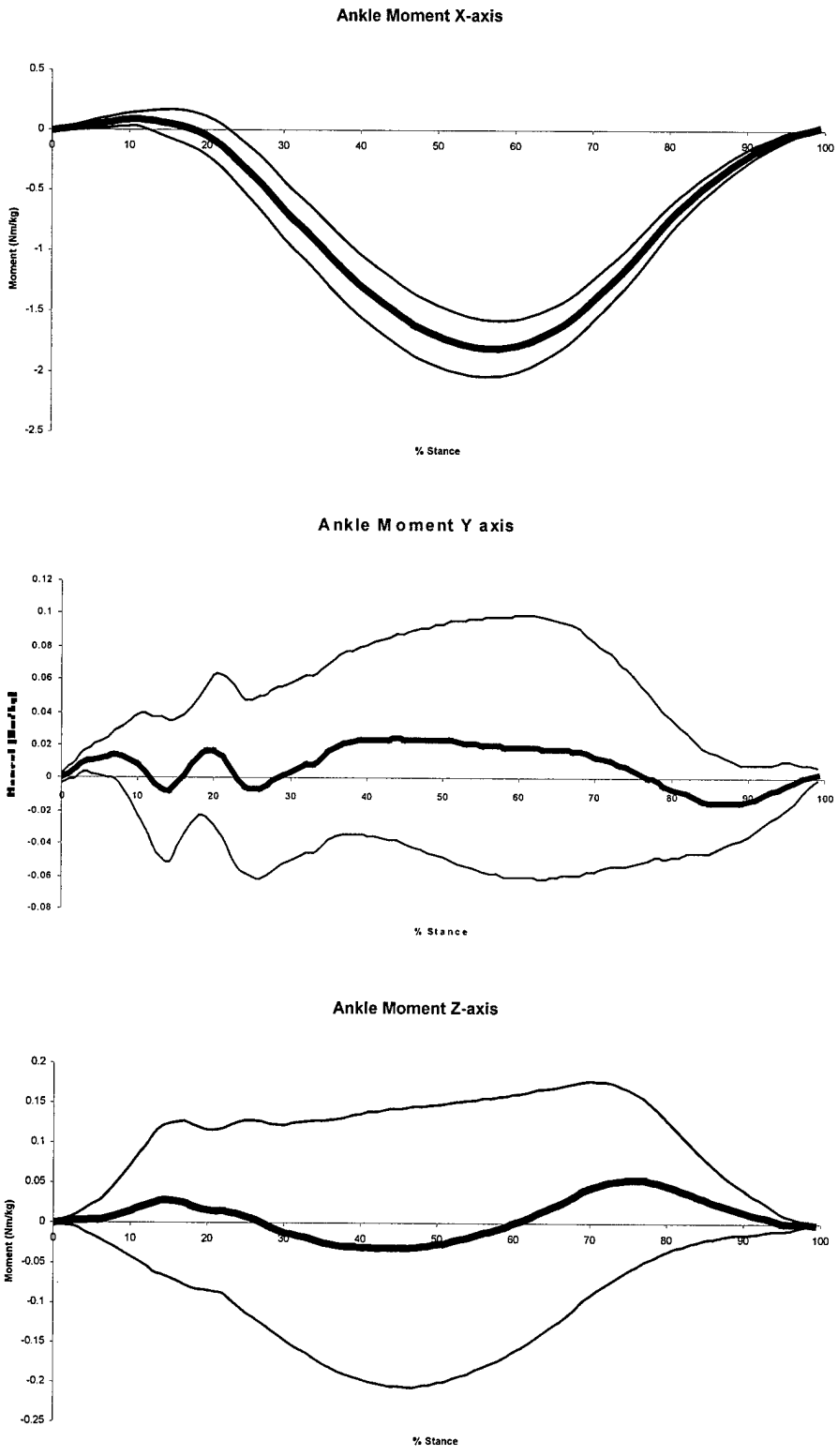


Figure 2. Ankle Moment in X (sagittal plane), Y (coronal plane), and Z (transverse plane) axes. Positive values indicate dorsiflexor moment (top), abduction moment (middle), and eversion moment (bottom).

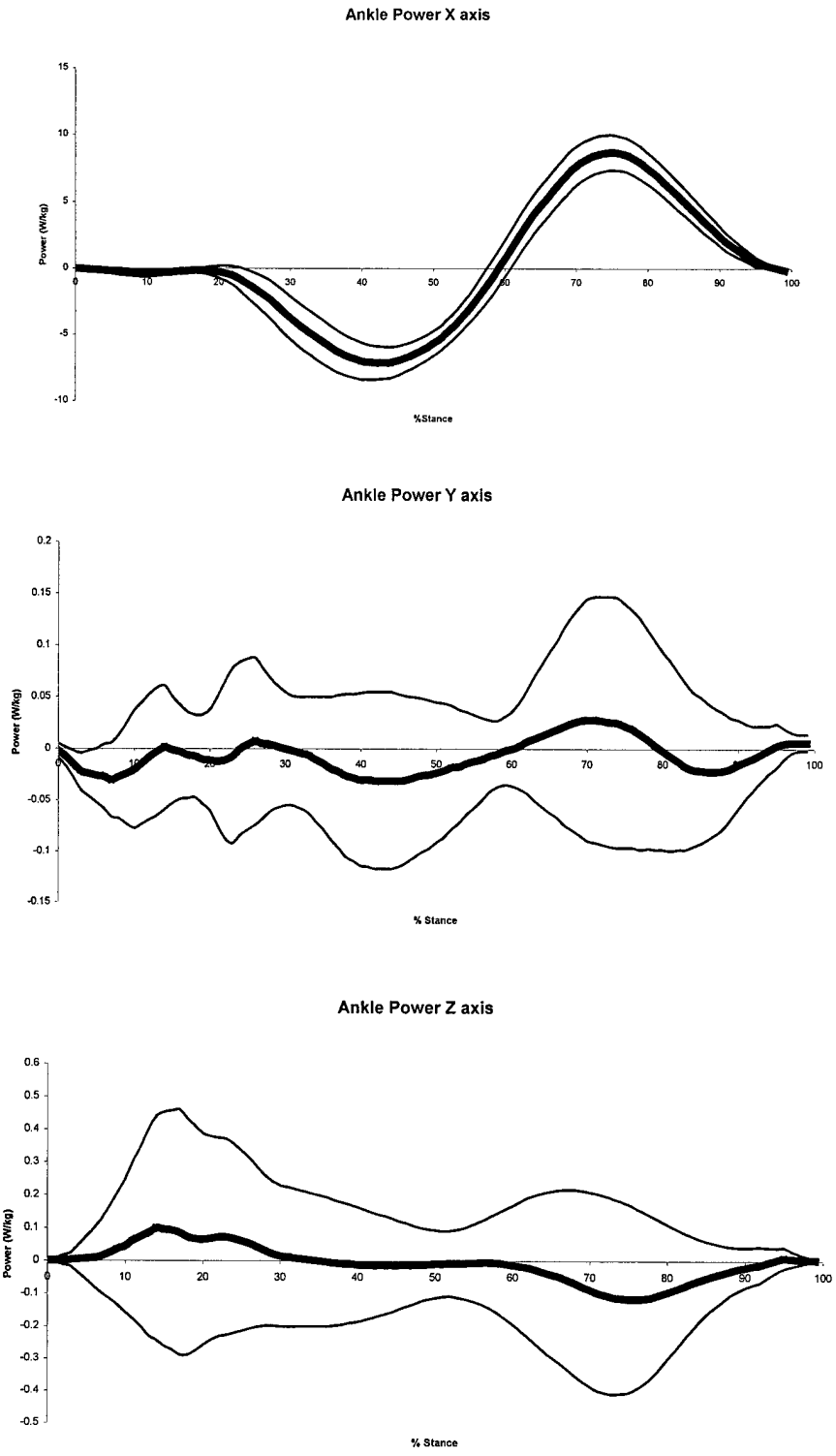


Figure 3. Ankle Power in X (sagittal plane), Y (coronal plane), and Z (transverse plane) axes. Positive values indicate energy generation, negative values indicate energy absorption.

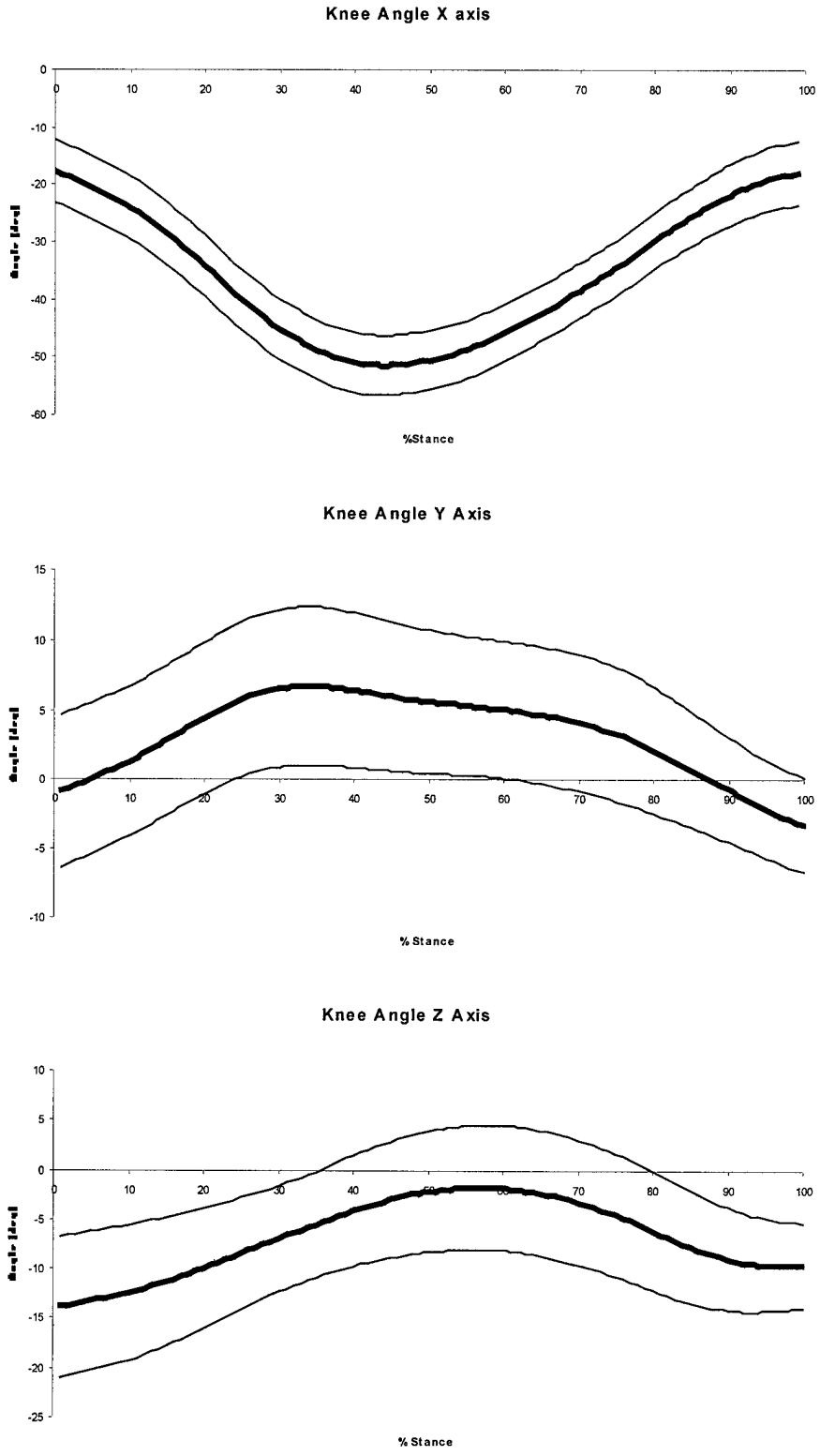


Figure 4. Knee Angle in X (sagittal plane), Y (coronal plane), and Z (transverse plane) axes. Positive values indicate extension (top), abduction (middle), and internal rotation (bottom).

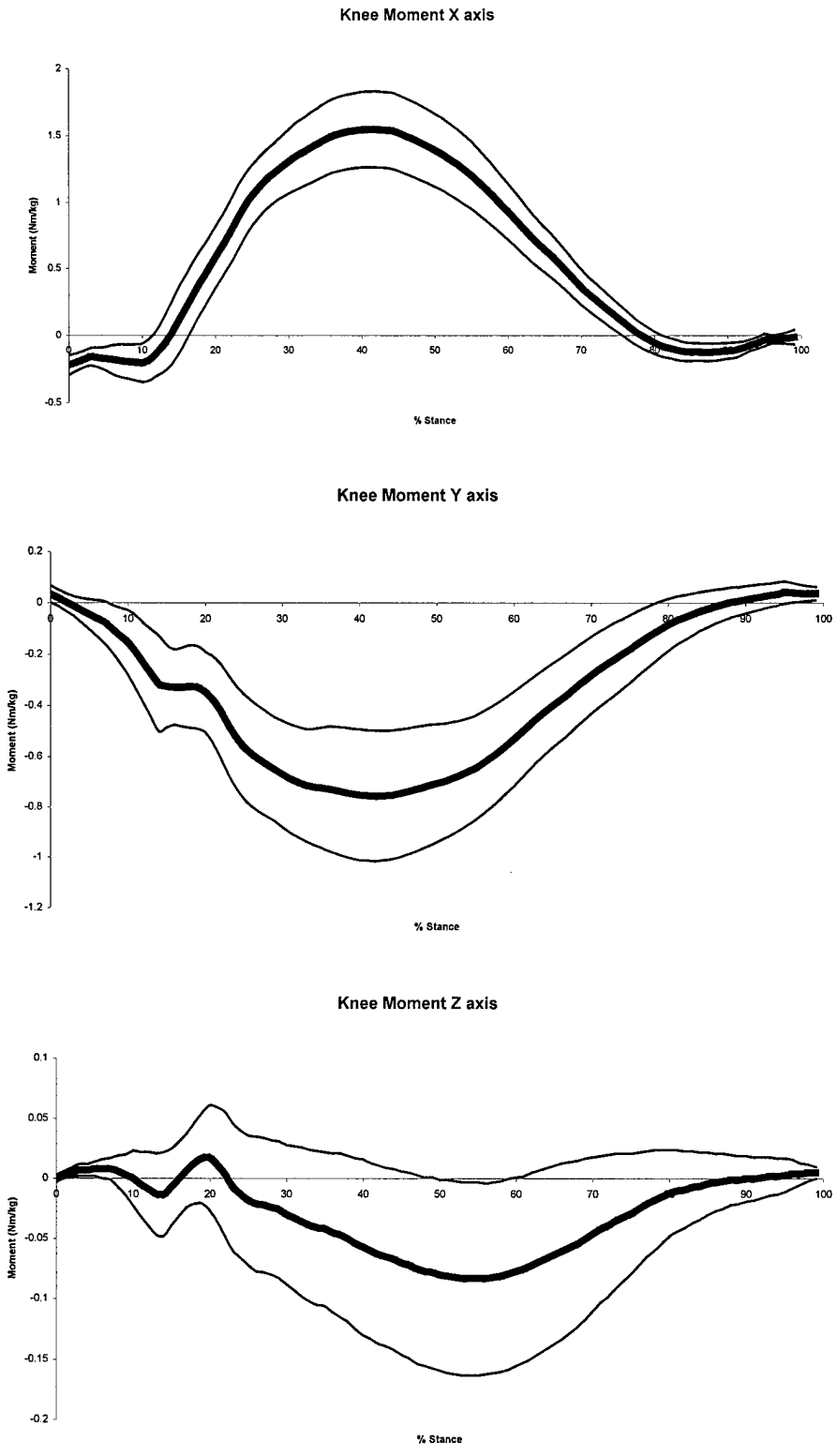


Figure 5. Knee Moment in X (sagittal plane), Y (coronal plane), and Z (transverse plane) axes. Positive values indicate extensor moment (top), abductor moment (middle), and internal rotation moment(bottom).

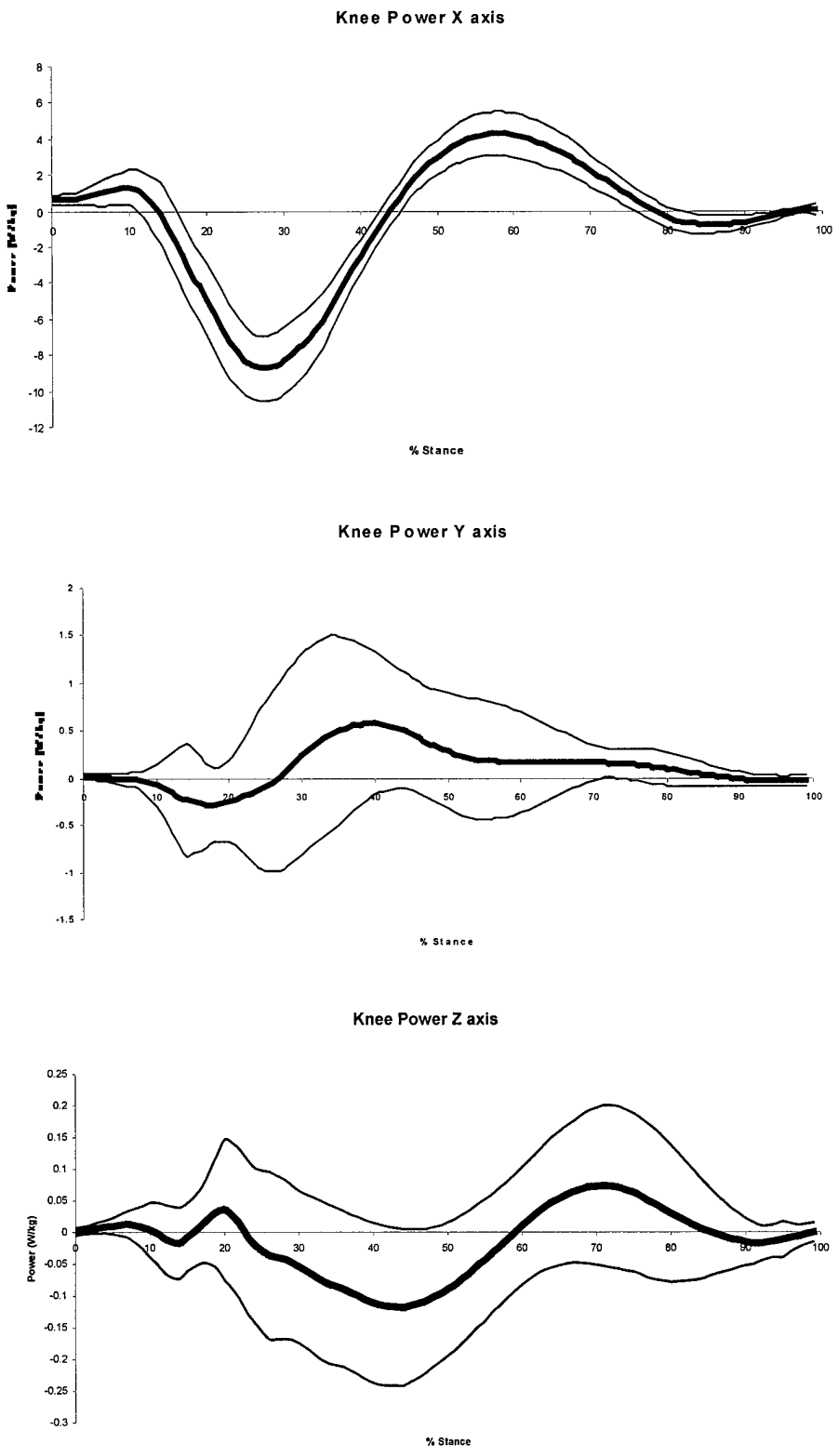


Figure 6. Knee Power in X (sagittal plane), Y (coronal plane), and Z (transverse plane) axes. Positive values indicate energy generation, negative values indicate energy absorption.

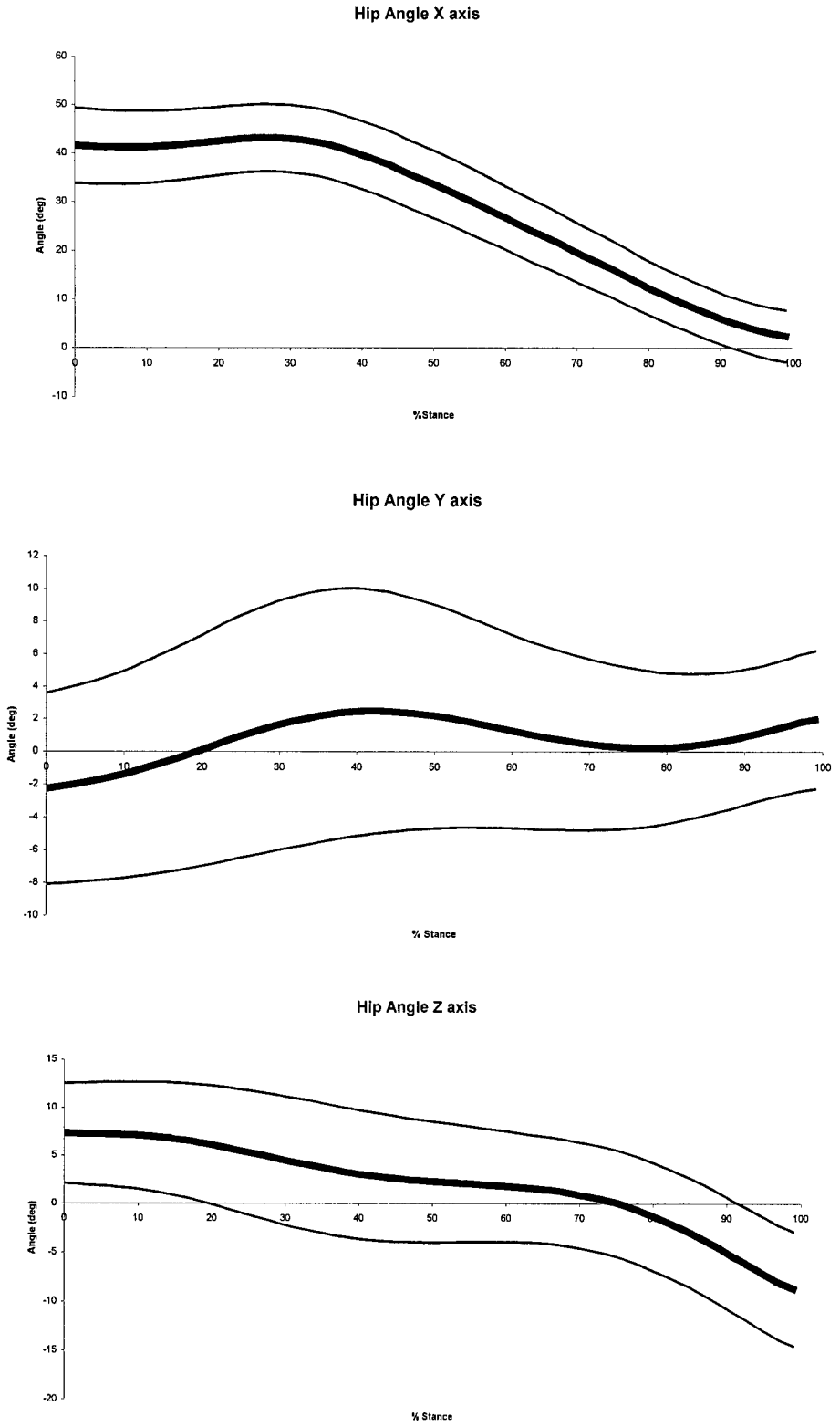


Figure 7. Hip Angle in X (sagittal plane), Y (coronal plane), and Z (transverse plane) axes. Positive values indicate extension (top), abduction (middle), and internal rotation (bottom).

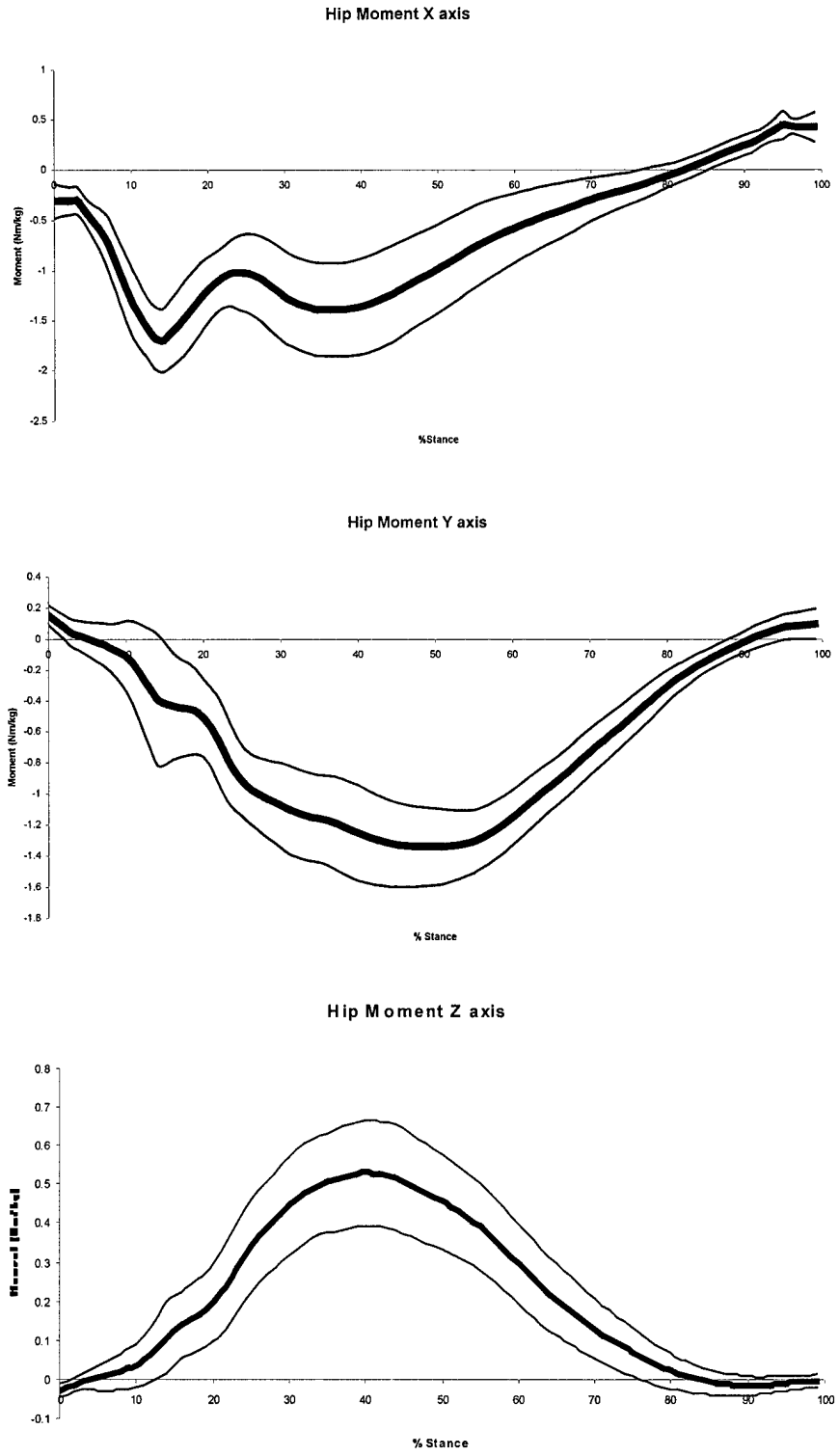


Figure 8. Hip Moment in X (sagittal plane), Y (coronal plane), and Z (transverse plane) axes. Positive values indicate extensor moment (top), abductor moment (middle), and internal rotation moment(bottom).

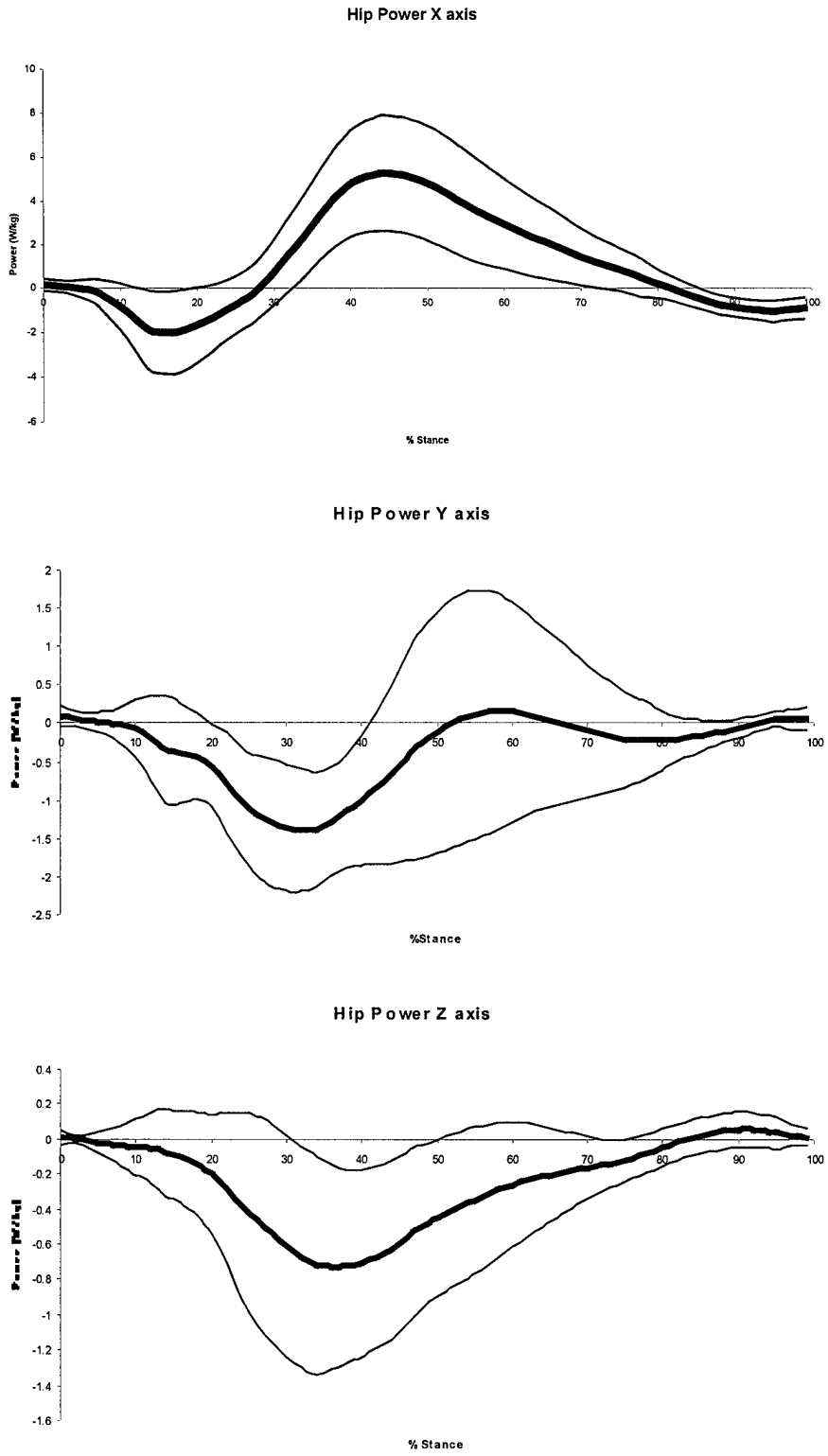


Figure 9. Hip Power in X (sagittal plane), Y (coronal plane), and Z (transverse plane) axes. Positive values indicate energy generation, negative values indicate energy absorption.

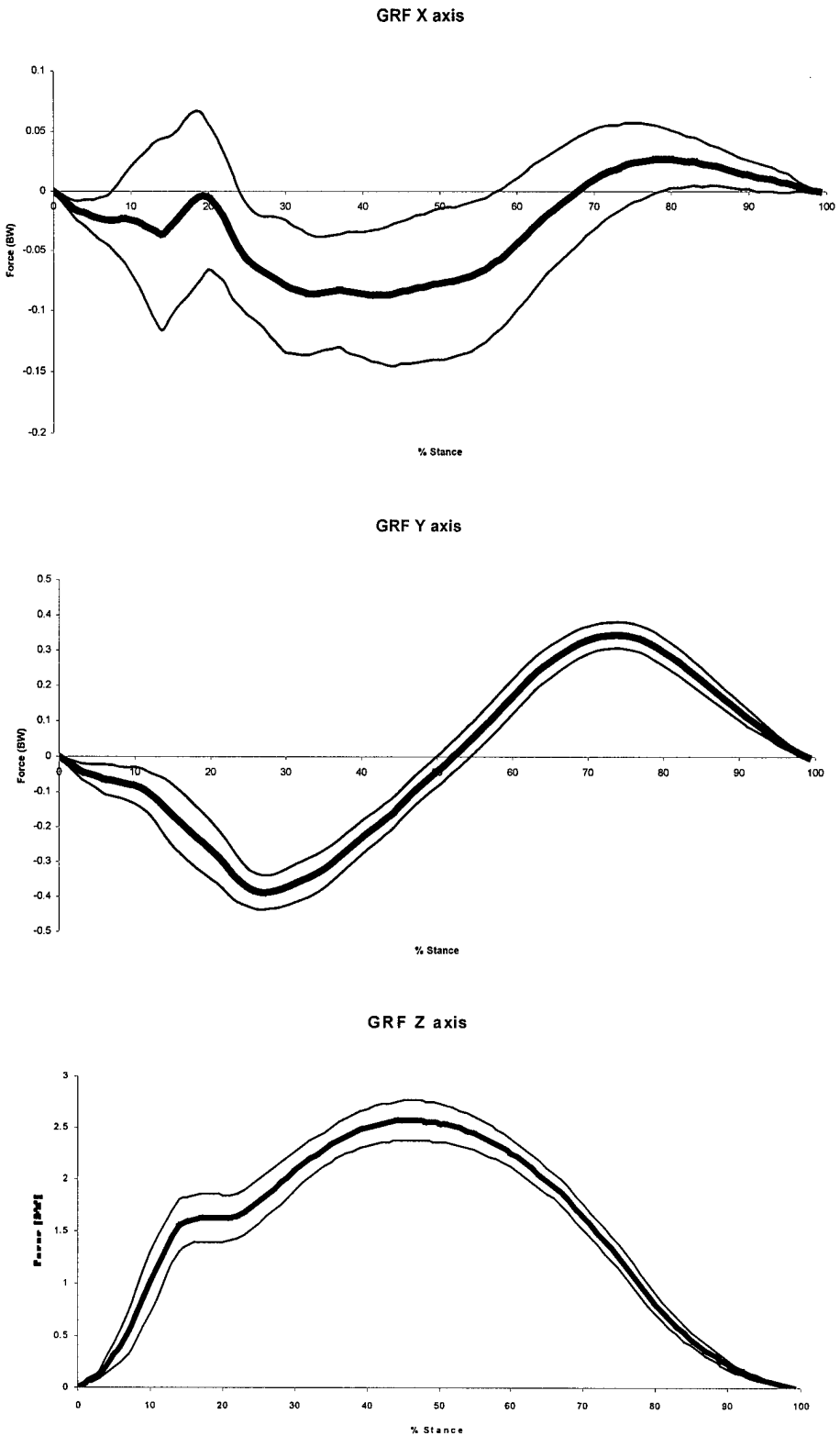


Figure 10. Ground Reaction Force for X (sagittal plane), Y (coronal plane), and Z (transverse plane) axes.

Appendix E: Curriculum Vitae for Irene S. McClay

Irene Sprague McClay

Curriculum Vitae

PERSONAL

PII Redacted

[redacted]

EDUCATION

PhD	1990	Pennsylvania State University	Biomechanics
MEd	1984	University of Virginia	Biomechanics
BS	1978	University of Florida	Physical Therapy
BS	1977	University of Mass.	Exercise Science

EMPLOYMENT

Director of Research, Joyner Sportsmedicine Institute, (6/97 - present)
Development of research within the Joyner Sportsmedicine Institute aimed at advancing the science of sportsmedicine and improving prevention, diagnosis and treatment of sports-related injuries.

Associate Professor, Program in Physical Therapy, University of Delaware. (5/97 - present)

Assistant Professor, Program in Physical Therapy, University of Delaware. (9/89 - 5/97)
Instruction of graduate students in physical therapy. Research in clinical biomechanics with specific interest in lower extremity mechanics and injury. Director, Running Injury Clinic.

Research Assistant, Pennsylvania State University, Center for Locomotion Studies. (8/85 6/89)
Responsible for the development and coordination of the Running Injury Clinic and Orthopedic Clinic. Research activities in locomotor biomechanics. Consultant to the Distance Runner's Camp at US Olympic Training Center.

Research and Teaching Assistant, University of Virginia, Rehabilitation Engineering Center. (8/82-8/85)

Research activities in wheelchair ergonomics. Instructor of graduate courses in biomechanics and human dissection. Co-coordinator of the Arts and Science of Sports Medicine Conference held annually at the University of Virginia (6/84, 6/85)

Physical Therapist, Blue Ridge Rehabilitation Associates, Charlottesville, VA (1/83 - 7/85)
Part time home health and private practice physical therapy.

Physical Therapist, Woodrow Wilson Rehabilitation Center, Fishersville, VA (2/79 - 6/82)
Patient treatment, supervision of physical therapy students, inservice training and Coordinator of the Amputee Clinic. Instructor in continuing education course in Management of the Spinal Cord Injured Patient.

GRANTS

In Review

The Biomechanics behind Successful Orthotic Intervention in Patients with Patellofemoral Pain Syndrome. Submitted to the Pauline Marshall Research and Education Foundation. $35,000 for 1 year. Preliminary proposal accepted - Invited to submit full application.

The Effect of Wedged Foot Orthoses on Lower Extremity Mechanics and Function in Patients with Knee Osteoarthritis. Submitted to the National Institutes of Health (COBRE Grant) $125,000/yr for 5 years (in review)

The Effect of a Training Program on Lower Extremity Injuries and Functional Performance in Collegiate Female Basketball Players. Submitted to the Orthopedic Research and Education Foundation. $150,000 for 3 yr. grant period (in review)

Funded

Biomechanical Factors Associated with the Etiology of Stress Fractures in Runners. The Department of the Army. $1.05 million for 5 yr grant period beginning 9/2000.

Doctoral Scholarship. $10,000. Joyner Sportsmedicine Institute, 1998, 1999, 2000, 2001

Undergraduate Summer Scholarship. $2,500. Joyner Sportsmedicine Institute, 1997 and 1998.

A Comparison of Four Methods to Obtain a Negative Impression of the Foot, $3,250, Foot Management, Inc, 1998-1999

The Effect of Different Orthotic Devices on Lower Extremity Mechanics of Rearfoot and Forefoot Strikers, $3,500. Foot Management, Inc, 1999-2000.

The Effect of the Protonics System on Patellar Aligment and Gait in Patients with Patellofemoral Joint Pain. $18,000. Funded by Inverse Technology, 1998-1999

Clinical Efficacy of the Protonics System in Patients with Patellofemoral Joint Pain. $3,000. Funded by Inverse Technology, 1998-1999

A Comparison of Strengthening vs. Orthotics on Pronation and Pronation Velocity. Funded by the Physical Therapy Foundation $60,000, 1993-1995

Lower Extremity Mechanics and Injury. Funded by the Whitaker Foundation $180,000, 1993-1996.

The Relationship between Subtalar Joint Axis Orientation, Joint Motion and Injuries in Runners. Funded by the Biomedical Research Support Grant. $2550, 1992

The Relationship between Subtalar Joint and Knee Joint Motion in Runners. Funded by the University of Delaware Research Foundation. $16,000, 1990.

A Comparison of Patellofemoral 3-D Kinematics in Runners with and without Patellofemoral Pain. Doctoral Dissertation. Foundation for Physical Therapy. $8500, 1988.

PUBLICATIONS

Williams, DS, McClay, IS, Hamill, J, Buchanan, TS (2001). Lower Extremity Kinematic and Kinetic Differences in Runners with High and Low Arches. *Journal of Applied Biomechanics.* 17:153-163.

Williams, DS, McClay, IS, Hamill, J, (2001). Arch Structure and Injury Patterns in Runners *Clinical Biomechanics* (16)5:341-347.

Laughton, CA, McClay, IS & Williams, DS (2001) Comparison of Methods of Obtaining a Negative Impression of the Foot. *Journal of the American Podiatric Society*

Ireland, ML, Ballantyne, BT, Little, K, McClay, IS. (2001) A Radiographic Analysis of the Relationship between the Size and Shape of the Intercondylar Notch and Anterior Cruciate Ligament Injury *Knee surgery, sports traumatology and arthroscopy.*9:200-205

Manal, KT, McClay, IS, Stanhope, S, & Richards, J (2000). Comparison of Surface Mounted Markers and Attachment Methods in Estimating Knee Moments during Walking. *Gait and Posture* 11:38-45.

Williams, DS & McClay, IS (2000). Measurements Used to Characterize the Foot and the Medial Longitudinal Arch:Reliability and Validity. *Physical Therapy* 80(9):864-871.

Williams, DS, McClay, IS, & Manal, KT. (2000) Mechanics of Runners with a Converted Forefoot Strike Pattern. *Journal of Applied Biomechanics* 16(2)210-218.

Manal, KT, McClay, IS, Stanhope, S, & Richards, J (2000). Comparison of Surface Mounted Markers and Attachment Methods in Estimating Tibial Rotations During Walking. *Gait and Posture* 11: 38-45

McClay, IS (2000) The Evolution of the Study of Running Mechanics: Relationships to Injury. *Journal of the American Podiatric Society* 90(3)133-148.

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McClay, IS & Manal, KT (1998). A Comparison of Three-dimensional Lower Extremity Kinematics during Running between Pronators and Normals. *Clinical Biomechanics* 13(3):195-203.

McClay, IS & Manal, KT (1998). The Relationship between Angle of Gait and Differences between Two-Dimensional and Three-Dimensional Rearfoot Motion. *Foot and Ankle* 19(1):26-31.

McClay, IS & Bray, J (1996). The Subtalar Angle - a potential measure of rearfoot structure. *Foot and Ankle,* 17(8):1-4

McClay, IS (1996). Statistically Significant, but Clinically Irrelevant. Guest Editorial, *Journal of Orthopedic and Sports Physical Therapy*, 23(12).

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McClay, IS, Robinson, JR, et al. (1994) "A Profile of Ground Reaction Forces in Professional Basketball Players." *Journal of Applied Biomechanics*, 10(3):222-236, 1994.

McClay, IS, Lake, MJ, & Cavanagh, PR (1990): "Muscle Activity in Running" in *The Biomechanics of Distance Running.* ed. PR Cavanagh, Human Kinetics, Champaign, Ill.

In Press

Manal, KT, McClay, IS, Stanhope, SJ, and Richards, J. Knee Moment Profiles during Walking: Errors due to Soft Tissue Movement and the Influence of the Reference Coordinate System. *Gait and Posture* (in press).

In Review

Wills, J , McClay, IS & Queale, WS (2001). Epidemiology of Extreme Sports (in review) *Medicine and Science in Sports and Exercise.*

Ott, S, Ireland, ML, Ballantyne, BT and McClay, IS (2001). Functional Outcome Measures following ACL Reconstruction: A Gender Comparison. (in review) *Clinical Orthopedics and Related Research*

Williams, DS, McClay, IS, Scholz, JP, Hamill, J, Buchanan, TS (2001). Lower extremity stiffness in runners with different foot types (in review) *Journal of Biomechanics*

Sahte, V, Ireland, ML, Ballantyne BT and McClay, IS (2001). Acute Effect of the Protonics System on Patellofemoral Alignment. (in review) *Knee surgery, sports traumatology and arthroscopy.*

Laughton, CA, McClay, IS, Hamill, J and Richards, J (2001). The Effect of Orthotic Intervention and Strike Pattern on Rearfoot Motion in Runners. (in review) *Journal of Applied Biomechanics*.

Laughton, CA, McClay, IS, Hamill, J and Richards, J (2001). The Effect of Orthotic Intervention and Strike Pattern on Tbial Shock in Runners. (in review) *Clinical Biomechanics*

ABSTRACTS

Laughton, CA, McClay, IS, Hamill, J Effect of Orthotic Intervention and Strike Pattern on Tibial Shock in Runners. Presented at the International Society of Biomechanics, Zurich, Switzerland, July, 2001

McClay, IS, Hughes, MA, Laughton, CA, Gupta, R. Effect of Soft Orthotics on Tibial Shock and Rearfoot Motion. Presented at the American College of Sports Medicine Mtg, Baltimore, June, 2001.

Manal, KT & McClay, IS Errors in Estimating Tibial Translation during Natural Cadence Walking: Bone vs. Skin Mounted Tracking Markers. Presented at the American College of Sports Medicine Mtg, Baltimore, June, 2001.

Laughton, CA, McClay, IS, & J. Hamill. Effect of Foot Orthoses and Strike Pattern on Rearfoot Motion. Presented at the American College of Sports Medicine Mtg, Baltimore, June, 2001.

Ballantyne, BT, Leetun, D, Ireland, ML, & McClay, IS. Gender differences in core stability as measured by trunk and hip performance Presented at the American College of Sports Medicine Mtg, Baltimore, June, 2001.

McCrory, JL, Quick, NE, Ballantyne, BT & McClay, IS. Effect of a Resistive Dynamic Knee Orthosis on Muscle Activations During the Lateral Step Up. Presented at the American College of Sports Medicine Mtg, Baltimore, June, 2001.

Laughton, CA and McClay, IS. Relationship between Loading Rates and Tibial Accelerometry in Forefoot Strike Runners. Presented at the Annual American Society of Biomechanics Mtg, Chicago, IL, July, 2000

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Hamill, J, Heidersheidt, B, McClay, IS, Li, L. Influence of Strike Pattern on Lower Extremity Stiffness in Runners. Presented at the Canadian Society of Biomechanics Mtg, Montreal, July, 2000.

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Sahte, V, Ireland, ML, Ballantyne BT and McClay, IS. Acute Effect of the Protonics System on Patellofemoral Alignment. Presented at the ACSM National Mtg in Indianapolis, IN, 6/00.

Ott, S, Ireland, ML, Ballantyne, BT and McClay, IS. Gender Differences in Functional Outcomes following ACL Reconstruction. Presented at the ACSM National Mtg in Indianapolis, IN, 6/00.

Williams, DS, McClay, IS & Laughton, CA. A Comparison of between day Reliability of Different Types of Lower Extremity Kinematic Variables in Runners. Presented at the American Society of Biomechanics, 10/99, Pittsburgh, PA.

McClay, IS, Williams, DS & Laughton, CA. Can Gait be Retrained to Prevent Injury in Runners? Presented at the American Society of Biomechanics, 10/99, Pittsburgh, PA.

McClay, IS, Williams, DS and Baitch, S. The Effect of the Inverted Orthotic on Lower Extremity Mechanics. Presented at the International Society of Biomechanics Mtg, 8/99, Calgary, Canada

McClay, IS, & Williams, DS. Structure and Mechanics of Injured Twin Runners. Presented at the ACSM National Mtg in Seattle, WA, 6/99.

Wills, J & McClay, IS. Epidemiology of Extreme Sports. Presented at the ACSM National Mtg in Seattle, WA, 6/99.

Crook, S, Ballantyne, BT & McClay, IS. Reliability of a Functional Assessment Tool. Presented at the ACSM National Mtg in Seattle, WA, 6/99.

Laughton, CA, McClay, IS and Williams, DS. A Comparison of Methods of Obtaining a Negative Impression of the Foot. Presented at the National APTA Conference, Washington, DC, 6/99

Williams, DS, McClay, IS. Reliability and Validity of Arch Characterizing Measurements. Presented at the Combined Sections Mtg of the APTA, Seattle, WA, 2/99.

McClay, IS, Williams, DS, and Manal, KT. Lower Extremity Mechanics of Runners with a Converted Forefoot Strike Pattern. NACOB, Chicago, IL, 1998

Manal, KT, McClay, IS et al. A Comparison of Surface Mounted Markers and Attachment Methods in estimating Tibial Rotations during Walking. Am. Soc. Biom. Mtg,,Clemson, SC, Oct, 1997

McClay, IS The Relationship between Lower Extremity Mechanics and Injury in Runners to be presented at the Whitaker Conference, Utah, August, 1996.

McClay, IS & Manal, KT A Comparison of Rearfoot and Knee Kinematics during Running between Excessive Pronators and Normals. Presented at the Canadian Orthopedic Research Society Meeting, Quebec City, May, 1996.

McClay, IS & Manal, KT Lower Extremity Kinematic Comparisons between Forefoot and Rearfoot Strikers. Presented at the American Society of Biomechanics Meeting, Stanford, CA 8/95

McClay, IS & Manal, KT Lower Extremity Kinetic Comparisons between Forefoot and Rearfoot Strikers. Presented at the American Society of Biomechanics Meeting, Stanford, CA 8/95

McClay, IS & Manal, KT Coupling Parameters in Runners who Pronate and Normals. Presented at the American Society of Biomechanics Meeting, Columbus, Ohio, 11/94.

McClay, IS & Manal, KT (1995). A Comparison of Two- and Three-dimensional Lower Extremity Kinematics during Running between Pronators and Normals. (Presented at the American Society of Biomechanics Meeting, Columbus, Ohio, 11/94.

McClay, IS, Cavanagh, PR, Sommer, HJ, & Kalenak, A: "Three-Dimensional Kinematics of the Patellofemoral Joint during Running". Proceedings of the American Society of Biomechanics Meeting, 10/91,Tempe, AZ.

McClay, IS, Cavanagh, PR, Sommer, HJ, & Kalenak, A: "The Effect of Orthotic Treatment on Tibiofemoral and Patellofemoral Joint Kinematics". *Physical Therapy,* 71(6):S46-7, 1991.

McClay, IS, Cavanagh, PR, Sommer, HJ, Woltring, HJ, & Kalenak, A: "Three-Dimensional Angular Kinematics of the Tibiofemoral Joint During Running". Proceedings of the International Symposium on 3-D Analysis of Human Movement, Montreal, 7/91.

Cavanagh, PR, Robinson, JR & McClay, IS: "Biomechanical Perspective of Stress Fractures in Professional Basketball Players". *Med Sci Sport and Exercise* 22:(2) S104, April, 1990.

Woltring, HJ, McClay, IS, & Cavanagh, PR: "3-D Photogrammetric Camera Calibration without a Calibration Object." Abstract published in the Proceedings of the International Society of Biomechanics Meeting, Los Angeles, CA, 6/89.

McClay, IS, Cavanagh, PR, & Kalenak, A: "Biomechanical Evaluation of the Injured Runner" Abstract published in the Proceedings of the East Coast Gait Conference, November, 1987.

Brubaker, CE, McClay, IS, & McLaurin, CA: "Effect of Seat Position of Propulsion Efficiency." Proceedings of the 2nd International Conference on Rehabilitation Engineering, 1984, pp. 134-138.

Brubaker, CE, McClay, IS, & McLaurin, CA: "The Effect of Mechanical Advantage on Lever Propulsion Efficiency". Proceedings of the 6th Annual Conference on Rehabilitation Technology, 1983, pp. 122-124.

SELECTED INVITED PRESENTATIONS

"Selected Case Studies in Running Injuries" Presented at the Combined Sections Meeting of the APTA, San Antonio, TX, Feb, 2001.

"Developing Standards in Epidemiological Research" Presented at the National ACSM Mtg in Indianapolis, June, 2000

"Lower Extremity Mechanics and Injury Patterns in High and Low Arch Runners". Keynote Presented at the Foot and Ankle Research Retreat, Annapolis, MD, May,2000

"Effect of the Inverted Orthotic on Rearfoot and Knee Mechanics" Presented at the 4th Annual John Weed Seminar, Palm Springs, CA, March, 2000 and the PFOLA meeting in Vancouver, BC, November 2000

"Influence of foot, knee and hip coupling on patellofemoral mechanics" Symposium at the Combined Sections Meeting of the APTA, New Orleans, LA, February, 2000 and at the National ACSM Mtg in Indianapolis, June, 2000, and the Arts and Science of Sports Medicine, Charlottesville, VA, June, 2000.

"Visual Gait Analysis in Runners" Presented at the Arts and Science of Sports Medicine, Charlottesville, VA, June, 2000.

"Injury Mechanisms in Runners" Keynote speaker at the Fifth IOC Congress on Sport Sciences, Sydney, Australia, November, 1999

"Clinical Gait Analysis" Keynote speaker at the Fifth IOC Congress on Sport Sciences, Sydney, Australia, November, 1999.

"Risk Factors in Anterior Cruciate Ligament Injuries" Clinical Colloqium presented at the National ACSM Mtg, in Seattle, WA, 6/99

"Problem Solving the Injured Runner" Clinical Colloqium presented at the National ACSM Mtg, in Seattle, WA, 6/99

"Coupling between the Foot and the Knee in Runners" Presented at Joyner Sportsmedicine Institute National Conference, Hilton Head, SC, 10/99

"Biomechanics of the Knee" Presented at Joyner Sportsmedicine Institute National Conference, Hilton Head, SC, 10/99

"Physical Therapist to Marathoner - A Classical Tale of Overuse." Presented at the Case Conference Seminar at the Annual Conference of the American Physical Therapy Association, Minneapolis, MN, 6/98.

Eugene Michels Research Forum - "Instrumented versus Visual Gait Analysis in Clinical Assessments" Presented at the Combined Sections Meeting in Dallas, TX, 2/97.

"Biomechanical Differences between Forefoot and Rearfoot Strikers" presented at the Joyner Sportsmedicine Institute 1996 National Conference, Hilton Head, SC, 11/96.

"Plantar Fasciitis:A Case Study" Presented at the Case Conference Seminar at the Annual Conference of the American Physical Therapy Association, Minneapolis, MN, 6/96.

"The Use of Motion Analysis in Physical Therapy". University of PA, Philadelphia, 10/95.

"The Patellofemoral Joint - Implications of the study of three-dimensional kinematics". Grand Rounds, Dept. of Orthopedic Surgery, Hershey Medical Center, 1/95.

"What is Clinical Research". Keynote Address at Research Symposium, Shenandoah University, 4/94 .

"Research in Foot and Ankle Biomechanics". Presented at the Combined Sections Meeting of the American Physical Therapy Association, New Orleans, LA, 2/94

"Biomechanical Assessment of Gait" Presented at the Arts and Science of Sports Medicine Conference, Charlottesville, Va., 6/93

"Closed Kinetic Chain Activities for the Foot and Ankle" Presented at the Foot and Ankle Seminar for HealthSouth in Orlando, FL, 2/93, Phoenix, AZ, 3/93, St. Louis, MO, 4/93 and for Foot Mgt, Inc in Ocean City, MD in 10/94 and 4/96.

"Normal Structure and Gait". Presented at the Arts and Science of Sports Medicine Conference, Charlottesville, Va., 6/92, and at the Symposium on the Biomechanics of the Lower Extremity, NATA, Denver, CO, 2/92.

"Abnormal Structure and Gait". Presented at the Arts and Science of Sports Medicine Conference, Charlottesville, Va., 6/92, and at the Symposium on the Biomechanics of the Lower Extremity, NATA, Denver, CO, 2/92 and for Foot Mgt, Inc in Ocean City, MD in 10/94 and 4/96.

"The Biomechanical Evaluation of the Injured Runner". Presented at the Medical Symposium of the Penn Relays, 4/92, The Arts and Science of Sports Medicine Conference, Charlottesville, Va., 6/88 and the East Coast Gait Conference, Bethesda, Md, 11/87

"Biomechanics of the Foot and Ankle". Presented at the Arts and Science of Sports Medicine Conference, Charlottesville, Va., 6/91.

"Relationship between Mechanics and Running Injuries". Presented at the Arts and Science of Sports Medicine Conference, Charlottesville, Va., 6/91.

"Anatomy and Biomechanics of the Patellofemoral Joint". Presented at the Sports Physical Therapy Meeting, Orlando, Fla. 12/90.

"Relationship between Structure and Function in Patellofemoral Disorders". Presented at the Sports Physical Therapy Meeting, Orlando, Fla. 12/90.

"Normal and Abnormal Running Mechanics". Presented at the Arts and Science of Sports Medicine Conference, Charlottesville, Va. 6/90.

"Biomechanical Perspective of Stress Fractures in Professional Basketball Players". Presented at the Annual Meeting of the NBA Physicians, West Palm Beach, Fl, 11/88.

"The Biomechanics of Patellofemoral Disorders". Presented at the Arts and Science of Sports Medicine Conference, Charlottesville, Va., 6/88.

"Biomechanical Profile of Elite Woman Distance Runners". Presented at the Dogwood Festival Pre-race Conference, Atlanta, GA, 7/88.

HONORS

Physical Therapy Foundation Scholar	1988
Recipient of Zipser Scholarship, The Penn State University	1988
Outstanding Masters Student Award, University of Virginia	1984
Nominee for Mary McMillan Scholarship Award, APTA	1978
Magna Cum Laude Graduate, University of Florida	1978
Magna Cum Laude Graduate, University of Massachusetts	1977

PROFESSIONAL ACTIVITIES

Societies

American Society of Biomechanics
- Organizing Committee, Annual ASB Mtg, Chicago, IL, July 2000
- Membership Committee (1997-present)
- Scientific Committee for the Third International Symposium on 3-D Analysis of Human Movement, Stockholm, Sweden, 1994

American College of Sports Medicine

American Physical Therapy Association (APTA)
- Orthopedic and Research Sections Member
- Chairperson of Research Committee of the Foot and Ankle Special Interest Group (1997-present)

International Society of Biomechanics

Advisory

Invited Participant to the "Working Conference on Gait Analysis in Rehabilitation Medicine" National Institutes for Health, September, 1996

Doctoral Research Advisory Committee, American Physical Therapy Association (1995-1997)

Medical Consultant for Runners World (1995-present)

Ed. Board

Clinical Biomechanics (1999-present)

Journal of Orthopedic and Sports Physical Therapy (1996-1997)

Journal of Applied Biomechanics (1997-1999)

Reviewer

Journal of Biomechanics

Medicine and Science in Sports and Exercise

Foot and Ankle, International

Journal of the American Podiatric Medical Association

Journal of Applied Biomechanics

Other

Organizing Chair for Research Retreat - Static and Dynamic Classification of the Foot. Annapolis, MD, May, 2000.

Organizing Chair for Research Retreat - ACL Injuries: The Gender Bias. Lexington, KY, April 2001.

Licensure

Licensed Physical Therapist, State of Delaware

Appendix F: Curriculum Vitae for Joseph Hamill

CURRICULUM VITAE

Joseph Hamill

Professor and Chair
Department of Exercise Science
Director, Biomechanics Laboratory
University of Massachusetts Amherst

and

Adjunct Professor
Department of Medicine
University of Massachusetts Medical Center

BUSINESS ADDRESS:

Biomechanics Laboratory
Department of Exercise Science
University of Massachusetts
Amherst, MA 01003
(413) 545-2245
(413) 545-2906 Fax
JHAMILL@EXCSCI.UMASS.EDU

PII Redacted [redacted] [redacted]

EDUCATION

1967	Teaching Certificate	Lakeshore Teacher's College, Toronto, Canada
1972	B.A.	York University, Toronto, Canada
1977	B.S. (magna cum laude)	Concordia University, Montreal, Canada
1978	M.S.	University of Oregon, Eugene, Oregon
1981	Ph.D.	University of Oregon, Eugene, Oregon

Undergraduate Areas of Study: Political Science
General Science
Graduate Area of Study: Biomechanics

RESEARCH INTERESTS

Mechanics of lower extremity function
Analysis of normal and pathological gait.
Modeling the lower extremity in gait.
Optimality criteria in human locomotion
Biomedical measurement technology

EMPLOYMENT EXPERIENCE

1977-1979	Graduate Teaching Fellow Biomechanics Laboratory, University of Oregon
1979-1981	Graduate Research Fellow Biomechanics Laboratory, University of Oregon
1981-1982	Post-doctoral Fellow Biomechanics Laboratory, University of Oregon
1982-1985	Assistant. Professor (Biomechanics) Department of Physical Education, Southern Illinois University
1985-1986	Assistant Professor (Biomechanics) and Graduate Program Director Department of Physical Education, Southern Illinois University
1986-1988	Assistant Professor (Biomechanics) Department of Exercise Science, University of Massachusetts
1989-1995	Associate Professor (Biomechanics) and Graduate Program Director Department of Exercise Science, University of Massachusetts
1990-	Adjunct Professor Department of Medicine, University of Massachusetts Medical Center
1995-1996	Associate Professor (Biomechanics) and Department Chair Department of Exercise Science, University of Massachusetts
1996-	Professor (Biomechanics) and Department Chair Department of Exercise Science, University of Massachusetts

RESPONSIBILITIES OF PRESENT POSITION

Department Chair
Director of the Biomechanics Laboratory
Teach graduate and undergraduate courses in Biomechanics
Advise undergraduate and graduate students
Chair graduate theses and dissertations in the Department
Conduct research in the area of Biomechanics
Secure external funding for the Biomechanics Laboratory

TEACHING RESPONSIBILITIES

At Southern Illinois University

P.E. 511	Mechanical Analysis
P.E. 512	Biomechanics of Sport
P.E. 505A	Biomechanics Instrumentation
P.E. 505B	Computer Applications
P.E. 505C	Biomechanics of the Musculo-skeletal System
P.E. 561	Doctoral Seminar
P.E. 302	Kinesiology for Physical Therapy
P.E. 370	Tests and Measurement

At University of Massachusetts

Ex Sc 300	Writing Seminar for Exercise Science
Ex Sc 305	Kinesiology
Ex Sc 304	Human Anatomy
Ex Sc 311	Anatomy of Human Motion
Ex Sc 531	Mechanical Analysis of Human Motion
Ex Sc 611	Introduction to Research
Ex Sc 732	Advanced Biomechanics
Ex Sc 892	Doctoral Seminar
Ex Sc 895	Clinical Biomechanics Seminar

UNIVERSITY SERVICE

Department Committees
- Master's Thesis Review Committee, 1982-1983
- Comprehensive Examination Review Committee, 1983-1984
- Chair, Graduate Faculty, 1982-1986
- Chair, Search Committee for Department Chairperson, 1986
- Graduate Committee, 1986-
- Telecommunications Committee, 1988-1990
- Chair, Department Personnel Committee, 1994-1995
- Chair, Motor Control Search Committee, 1994-1995

College Committees
- College Computer Advisory Committee, 1982-1986
- School Personnel Committee, 1994-1995
- School Executive Committee, 1995-
- Member, School Development Officer Search Committee, 1997.

University Committees
- Graduate Council, 1991
- Recruitment and Retention Committee, 1991-92
- Research Council, 1992-1995

PROFESSIONAL ORGANIZATIONS

American Alliance for Health, Physical Education, Recreation and Dance
Biomechanics Academy of the Research Consortium
International Society of Biomechanics
Canadian Society of Biomechanics
American College of Sports Medicine
New England College of Sports Medicine
American Society of Biomechanics
International Society of Biomechanics in Sport
ASTM

RESEARCH AFFILIATIONS

Scientific Advisory Board, Rockport Walking Institute, 1986-1992.
Scientific Advisory Board, LifeFitness, Inc., 1993-
Scientific Advisory Board, USA Field Hockey, 1995-1998
USA Volleyball Sports Medicine and Performance Commission's Resource Advisory Committee, 1996-1999

ACADEMIC HONORS

Fellow, Research Consortium of the AAHPERD, 1984
Fellow, American College of Sports Medicine, 1986
Fellow, American Academy of Kinesiology and Physical Education, 1997

OFFICES IN PROFESSIONAL ORGANIZATIONS

1.Chair-elect, Kinesiology Academy, 1990-91.
2.Board Member, International Society of Biomechanics in Sports, 1992-94.
3. Chair, Biomechanics Interest Group of the American College of Sports Medicine, 1996-97.
4. Member-at-large, Executive Committee of the New England Chapter of the American College of Sports Medicine, 1995-
5.Board Member, International Society of Biomechanics Technical Group on Footwear, 1998-2000
6. Member, Credentials Committee, American College of Sports Medicine, 2000-
7. Member-at-Large, Executive Board of Canadian Society of Biomechanics, 2000-

PROFESSIONAL SERVICE

Review Committees For Professional Meetings

1. Abstract Review Committee, American College of Sports Medicine Annual Meeting, 1989.
2. Abstract Review Committee, American College of Sports Medicine Annual Meeting, 1990.
3. Program Committee, combined meeting of the 9th International Symposium on Biomechanics in Sports and the Kinesiology Academy, June 29 - July 7, 1991.
4. Abstract Review Committee, American College of Sports Medicine Annual Meeting, 1991.
5. Review Panel Chair for Research Consortium, AAHPERD Convention, 1991-92.
6. Abstract Review Committee, American College of Sports Medicine Annual Meeting, 1992.
7. Review Panel Chair for Research Consortium, AAHPERD Convention, 1992-93.
8. Abstract Review Committee, American College of Sports Medicine Annual Meeting, 1993.
9. Abstract Review Committee, American College of Sports Medicine Annual Meeting, 1994.
10. Scientific Committee, International Society of Biomechanics in Sports Annual Meeting, Budapest, Hungary, June 1-6, 1994.
11. Abstract Review Committee, American College of Sports Medicine Annual Meeting, 1995.
12. Member, Scientific Review Committee, International Society of Biomechanics in Sports Annual Meeting, Madiera, Portugal, 1995-96.
13. Program Committee, New England American College of Sports Medicine Annual Meeting, Providence, RI, 1999.
14. Program Committee, New England American College of Sports Medicine Annual Meeting, Providence, RI, 2000.
15. Abstract Reviewer, XVIIIth Congress of the International Society of Biomechanics, ETH Zurich, Switzerland, July, 2001.
16. Abstract Reviewer, Vth Symposium of the Footwear Working Group Symposium of the International Society of Biomechanics, July, 2001

External Reviewer for Theses and Dissertations

1. External Dissertation Reviewer, McMaster University, Hamilton, Ontario, Canada, June, 1995.
2. External Thesis Reviewer, Lakehead University, Thunder Bay, Ontario, Canada, June, 1995.
3. External Dissertation Reviewer, University of Guelph, Guelph, Ontario, Canada, January, 1997.
4. External Dissertation Reviewer, University of Connecticut, Storrs, Connecticut, December, 1998.
5. External Dissertation Reviewer, University of Delaware, Newark, Delaware, March, 2000.
6. External Thesis Reviewer, University of Delaware, November, 2000.

External Grant Reviewer

1. External Reviewer for internal grants at University of Texas at Tyler, 1991.
2. Grant Reviewer, Natural Sciences and Engineering Council of Canada, 1993.
3. External Grant Reviewer, University Grants Committee, Hong Kong, February, 1998.
4. External Grant Reviewer, Natural Sciences and Engineering Council of Canada, May, 2000.

Committee Member

1. Biomechanics Model Research Laboratory, Olympic Scientific Congress, University of Oregon, July, 1984.
2. Completed Research in Health, Physical Education, Recreation and Dance, 1986.
3. Research Consortium Program Review Committee, AAHPERD Annual Convention, April, 1987.
4. Kinesiology Academy, Nominating Board for Officers, 1987.
5. Completed Research in Health, Physical Education, Recreation and Dance, 1988.
6. Nominating Committee for Kinesiology Academy Chair, 1991.
7. Delegate to American Alliance Assembly, January 1, 1991 to December 31, 1991.
8. ASTM Committee F-8 on Sports Equipment and Facilities, June, 1992.
9. Conference Chair, International Society of Biomechanics in Sport Annual Meeting, University of Massachusetts Amherst, June 23-26, 1993.
10. Doctoral Program Evaluation Committee, AAKPE, 1997.
11. Program Review Committee for Biomechanics, Michigan State University, East Lansing, MI, January, 2000.

EDITORIAL BOARD OF PROFESSIONAL JOURNALS

Member, Editorial Review Board, Pediatric Exercise Science, 1988-
Member, Editorial Review Board, Medicine, Exercise, Nutrition, and Health, 1991-1995
Guest Editor, special issue of Pediatric Exercise Science, The Physically Challenged Child, May, 1992.
Section Editor, Biomechanics, Research Quarterly for Exercise and Sport, 1993-96
Member, Editorial Review Board, Journal of Applied Biomechanics, 1996-1999
Member, Research Quarterly for Exercise and Sport Editorial Board, 1998-
Associate Editor, Medicine and Science in Sports and Exercise, 2000-
Member, Editorial Review Board, Sports Biomechanics, 2000-
Member, Advisory Editorial Board, Journal of Sports Sciences, 2001-

REVIEWER FOR PROFESSIONAL JOURNALS

Reviewer, Medicine and Science in Sports and Exercise, 1985-
Reviewer, International Journal of Sports Biomechanics, 1986-
Reviewer, Research Quarterly for Exercise and Sport, 1989-
Reviewer, Sports Medicine, 1991-
Reviewer, Journal of Gerontology, 1991-
Reviewer, Journal of Orthopaedic and Sports Physical Therapy, 1991-
Reviewer, Journal of Applied Biomechanics, 1993-
Reviewer, Journal of Applied Physiology, 1993-
Reviewer, Journal of Biomechanics, 1993-
Reviewer, Clinical Journal of Sports Medicine, 1996-
Reviewer, British Journal of Sports Medicine, 1996-
Reviewer, Clinical Biomechanics, 1999-
Reviewer, Exercise and Sports Science Review, 2000-
Reviewer, European Journal of Applied Physiology, 2000-

PUBLICATIONS

Osternig, L. R., Sawhill, J. A., Bates, B. T., Hamill, J. A method for rapid collection and processing of isokinetic data. *Research Quarterly for Exercise and Sport* 53(3):252-257, 1982.

Knutzen, K. M., Bates, B. T., Hamill, J. Electrogoniometry of post surgical knee bracing in running. *American Journal of Physical Medicine* 62(4):172-181, 1983.

Osternig, L. R., Hamill, J., Sawhill, J. A., Bates, B. T. Influence of torque and joint speed on power production. *American Journal of Physical Medicine* 62(4): 163-171, 1983.

Hamill, J., Bates, B. T., Sawhill, J. A., Knutzen, K. M. Variations in ground reaction force parameters at different running speeds. *Human Movement Sciences* 2:47-56, 1983.

Hamill, J., Bates, B. T., Knutzen, K. M. Ground reaction force symmetry during walking and running. *Research Quarterly for Exercise and Sport* 55(3):289-293, 1984.

Knutzen, K. M., Bates, B. T., Hamill, J. Knee brace influences on the tibial rotation and torque patterns of the surgical limb. *Journal of Orthopaedic and Sports Physical Therapy* 6(2):116-122, 1984.

Osternig, L. R., Hamill, J., Corcos, D. M., Lander, J. E. Electromyographic patterns accompanying isokinetic exercise under varying speed and sequencing conditions. *American Journal of Physical Medicine* 63(6):289-297, 1984.

Knutzen, K. M., Hamill, J., Bates, B. T. Ambulatory characteristics of the visually disabled. *Human Movement Sciences* 4:55-66, 1985.

Lander, J. E., Bates, B. T., Sawhill, J. A., Hamill, J. A comparison between free-weight and isokinetic bench pressing. *Medicine and Science in Sports and Exercise* 17(3): 344-353, 1985.

Smith, P. K., Hamill, J. The effect of punching glove type and skill level on momentum transfer. *Human Movement Studies* 12(3):153-161, 1986.

Hamill, J., Knutzen, K. M., Bates, B. T., Kirkpatrick, G. M. Evaluation of two ankle appliances using ground reaction force data. *Journal of Orthopaedic and Sports Physical Therapy* 7(5):244-249, 1986.

Osternig, L. R., Hamill, J., Lander, J. E., Robertson, R. Coactivation of sprinter and distance runner agonist/antagonist muscles in isokinetic exercise. *Medicine and Science in Sports and Exercise* 18(4):431-435, 1986.

Hamill, J., Ricard, M. D., Golden, D. M. Angular momentum in multiple rotation non-twisting platform dives. *International Journal of Sport Biomechanics* 2(2): 78-87, 1986.

Knutzen, K. M., Bates, B. T., Schot, P., Hamill, J. Knee brace evaluation. *Medicine and Science in Sports and Exercise* 19(3):303-309, 1987.

Hamill, J., Murphy, M. V., Sussman, D. H. The effects of track turns on lower extremity function. *International Journal of Sport Biomechanics* 3(3):276-286, 1987.

Hamill, J., Morin, G., Clarkson, P. M., Andres, R. O. Exercise moderation of foot function during walking with a re-usable semirigid ankle orthosis. *Clinical Biomechanics* 3(3):153-158, 1988.

Hamill, J., Bates, B. T. A kinetic evaluation of the effects of in vivo loading on running shoes. *Journal of Orthopaedic and Sports Physical Therapy* 10(2):47-53, 1988.

Hamill, J., Freedson, P. S., Boda, W., Reichsman, F. Effects of shoe type and cardiorespiratory responses and rearfoot motion during treadmill running. *Medicine and Science in Sports and Exercise* 20(5):515-521, 1988.

Greer, N. L., Hamill, J., Campbell, K. R. Ground reaction forces in children's gait. *Pediatric Exercise Science* 1(1):45-53, 1989.

Hamill, J., Knutzen, K. M., Bates, B. T., Kirkpatrick, G. M. Relationship of static and dynamic measures of the lower extremity. *Clinical Biomechanics* 4(4):217-225, 1989.

Greer, N. L., Hamill, J., Campbell, K. R. Dynamics of children's gait. *Human Movement Sciences* 8:465-480, 1989.

Brown, D. B., Knowlton, R. G., Hamill, J., Schneider, T. L., Hetzler, R. K. Physiological and biomechanical differences between wheelchair-dependent and able-bodied subjects during wheelchair ergometry. *European Journal of Applied Physiology* 60:179-182, 1990.

Holt, K. G., Hamill, J., Andres, R. O. The force driven harmonic oscillator as a model for human locomotion. *Human Movement Science* 9:55-68, 1990.

Hamill, J., McNiven, S. L. Reliability of ground reaction force parameters during walking. *Human Movement Science* 9:117-131, 1990.

Robertson, R. N., Osternig, L. R., Hamill, J., DeVita, P. EMG-torque relationships during isokinetic dynamometer exercise. *Sports Training, Medicine and Rehabilitation* 2:1-10,1990.

Holt, K. G., Hamill, J., Andres, R. O. Predicting the minimal energy cost of human walking. *Medicine and Science in Sports and Exercise* 23(4):491-498, 1991.

Hamill, J., Freedson, P. S., Clarkson, P. M., Braun, B. Muscle soreness during running: biomechanical and physiological implications. *International Journal of Sports Biomechanics* 7(2):125-137, 1991.

Devita, P., Hong, D. M., Hamill, J. Effects of asymmetric load carrying on the biomechanics of walking. *Journal of Biomechanics* 24(12):1119-1129, 1991.

Ebbeling, C. J., Hamill, J., Freedson, P. S., Rowland, T. W. Efficiency in Children's Gait. *Pediatric Exercise Science.* 4(1):36-49, 1992.

Widrick, J., Freedson, P. S., Hamill, J. Effect of internal work on the calculation of optimal pedalling rates. *Medicine and Science in Sports and Exercise* 24(3): 376-382, 1992.

Hamill, J., Bates, B. T., Holt, K. G. Timing of lower extremity joint actions during treadmill running. *Medicine and Science in Sports and Exercise* 24(7):807-813 1992.

Foti, T., Ebbeling, C. J., Hamill, J., Ward, A., Rippe, J. Stair climbing machines: Lower extremity kinematics and exercise intensity comparisons. *Medicine, Exercise, Nutrition, and Health* 2:162-169, 1993.

Ebbeling, C. J., Hamill, J., Crussemeyer, J. A. Lower extremity mechanics and the energy cost of walking in high-heeled shoes. *Journal of Orthopaedic and Sports Physical Therapy* 19 (4):190-196, 1994.

Holt, K. G., Jeng, S. F., Ratcliffe, R., Hamill, J. Energetic cost and stability during human walking at the preferred stride frequency. *Journal of Motor Behavior* 27(2): 164-178, 1994.

Hamill, J., Derrick, T. R., Holt, K. G. Shock attenuation and stride frequency during running. *Human Movement Science* 14:45-60, 1995.

Whittlesey, S. N., Hamill, J. An alternative model of the lower extremity during locomotion. *Journal of Applied Biomechanics* 12(2):269-279, 1996.

Jensen, R. L., Freedson, P. S., Hamill, J. The prediction of power and efficiency during near-maximal rowing. *European Journal of Applied Physiology* 73:98-104, 1996.

Hamill, J., Caldwell, G. E., Derrick, T. R. Reconstructing digital signals using Shannon's Sampling Theorem. *Journal of Applied Biomechanics* 13:226-238, 1997.

Mahar, A. T., Derrick, T. R., Hamill, J., Caldwell, G. E. Impact shock and attenuation during in-line skating. *Medicine and Science in Sports and Exercise* 29(8):1069-1075, 1997.

Derrick, T. R., Hamill, J., Caldwell, G. E. Energy absorption in conditions of various stride frequencies. *Medicine and Science in Sports and Exercise* 30(1):128-135, 1998.

Hamill, J., van Emmerik, R. E. A., Heiderscheit, B. C., Li, L. A dynamical systems approach to the investigation of lower extremity running injuries. *Clinical Biomechanics* 14(5):297-308, 1999.

Li, L., Hardin, E. C., Caldwell, G. E., Van Emmerik, R. E. A., Hamill, J. Coordination patterns of walking and running at similar speed and stride frequency. *Human Movement Science* 18:67-85, 1999.

Heiderscheit, B. C., Hamill, J., Van Emmerik, R. E. A. Influence on Q-angle on the variability of lower extremity segment coordination during running. *Medicine and Science in Sport and Exercise* 31(9):1313-1319, 1999.

Derrick, T. R., Caldwell, G. E., Hamill, J. Modeling the stiffness characteristics of the human body while running at various stride frequencies. *Journal of Applied Biomechanics* 16:36-51, 2000.

Heiderscheit, B. C., Hamill, J., Caldwell, G. E.: Influence on Q-angle on lower extremity kinematics during running. *Journal of Orthopedic and Sports Physical Therapy*, 30(5):271-278, 2000.

McCaw, S. T., Heil, M. E., Hamill, J. The effect of comments about shoe construction on impact forces during walking. *Medicine and Science in Sport and Exercise* 32(7):1258-1264, 2000.

Whittlesey, S. N., Van Emerik, R. E. A., Hamill, J. The swing phase of human walking in not a passive movement. *Motor Control*, 4(3):273-292 2000.

Hamill, J., Haddad, J.M., McDermott, W.J. Issues in quantifying varaibility from a dynamical systems perspective. *Journal of Applied Biomechanics*, 16:409-420, 2000.

Williams, D. S., McClay, I. S., Hamill, J., Buchanan, T. S. Lower extremity kinematic and kinetic differences in runners. *Journal of Applied Biomechanics* 17:153-163, 2001.

Williams, D. S., McClay, I. S., Hamill, J. Arch structure and injury patterns in runners. *Clinical Biomechanics* 16(4):341-347, 2001

Hardin, E. C., Hamill, J. The influence of midsole cushioning on mechanical and hematological responses during a prolonged downhill run. *Research Quarterly for Exercise and Sport* (in press), 2001.

MANUSCRIPTS UNDER REVIEW

Hardin, E., Hamill, J. The influence of shoe/surface interactions on impact shock attenuation. Journal of Applied Biomechanics, 1999.

Heiderscheit, B., Hamill, J., Van Emmerik, R. Locomotion variability and patellofemoral pain. Journal of Applied Biomechanics, 2001.

O'Connor, K., Hamill, J. Rearfoot motion and impact shock while running on cambered roads. Journal of Applied Biomechanics, 2001.

Laughton, C., McClay, I., Hamill, J. Orthotic intervention and rearfoot motion in forefoot and rearfoot strike running patterns. Clinical Biomechanics, 2001.

Li, L., Hamill, J. Non-linear behavior of gait transitions. Research Quarterly for Exercise and Sport, 2001.

MANUSCRIPTS IN PREPARATION

Derrick, T. R., Caldwell, G. E., Hamill, J.: The effect of simulated MUAP shape, rate and variability on the power spectrum.

Hamill, J., Derrick, T. R.: Co-contraction of lower extremity muscles under varying stride frequency conditions.

Hamill, J., Derrick, T.R., McClay, I. Joint stiffness during running with different footfall patterns.

PROCEEDINGS

Bates, B. T., Sawhill, J. A., Hamill, J. Dynamic running shoe evaluation. In Proceedings of Human Locomotion, Special Conference of the Canadian Society of Biomechanics, 122-124, London, Ontario, October, 1980.

Hamill, J., Bates, B. T., White, C. A. Evaluation of foot orthotic appliances using ground reaction force data. In Proceedings of Human Locomotion II, Special Conference of the Canadian Society of Biomechanics, 74-76, Kingston, Ontario, September, 1982.

Osternig, L. R., Sawhill, J. A., Bates, B. T., Hamill, J. Function of limb speed on torque patterns of antagonist muscles. In Biomechanics VIII-A, International Series on Biomechanics, Vol. 4B, H. Matsui and K. Kobayashi (eds.), 251-257, Human Kinetics Publishers, Champaign, IL, 1983.

Bates, B. T., Sawhill, J. A., Hamill, J., Osternig, L. R. Identification of critical variables describing ground reaction forces during running. In Biomechanics VIII-B, International Series on Biomechanics, Vol. 4B, H. Matsui and K. Kobayashi (eds.), 635-640, Human Kinetics Publishers, Champaign, IL, 1983.

Hamill, J., Knutzen, K. M., Bates, B. T. Ambulatory consistency of the visually impaired. In Biomechanics IX-A, International Series on Biomechanics, DA Winter, RW Norman, RP Wells, KC Hayes, AE Patla (eds.), 570-575, Human Kinetics Publishers, Champaign, IL, 1985.

Bates, B. T., Hamill, J., Morrison, E. A comparison between forward and backward running. In Proceedings of the Olympic Scientific Congress, M. Adrian and H. Deutsch (eds.), 127-136, Microform Publications, Eugene, OR, 1986.

Knutzen, K. M., Hamill, J. Evaluation of ankle taping and bracing influences during the support phase of running. In Proceedings of the Olympic Scientific Congress, M. Adrian and H. Deutsch (eds.), 151-158, Microform Publications, Eugene, OR, 1986.

Smith, P. K., Hamill, J. Selected karate and boxing glove impact characteristics during the punch. In Proceedings: Third International Society of Biomechanics in Sport Symposium, J. Terauds and J. Barham (eds.), 114-122, Academic Publishers, CA, 1986.

Hamill, J., Golden, D. M., Ricard, M. D., Williams, M. A. Dynamics of selected tower dive take-offs. In Proceedings: Third International Society of Biomechanics in Sport Symposium, J. Terauds and J. Barham (eds.), 200-207, Academic Publishers, CA, 1986.

Holt, K. G., Hamill, J., O'Connor, D. Effects of orthotic inserts adjusted for walkers with rearfoot dysfunction. In Proceedings of Fifth Biennial Conference of the Canadian Society of Biomechanics, 80-81, Ottawa, Canada, 1988.

Boda, W. L., Hamill, J., Homa, K. Effects of shoe type and walking speed on lower extremity kinematics. In Proceeding of the Fifth Biennial Conference of the Canadian Society of Biomechanics, 44-45, Ottawa, Canada, 1988.

Bates, B. T., Hamill, J., DeVita, P. The evaluation of strategies used to accommodate additional loads during running. In Proceedings of the Fifth Biennial Conference of the Canadian Society of Biomechanics, 40-41, Ottawa, Canada, 1988.

Knutzen, K. M., Hamill, J., Brilla, L., Peterson, B. Biomechanical evaluation of aerobic shoes. In Biomechanics XI-B, International Series on Biomechnics, G. deGroot, A.P. Hollander, P.A. Huljing, G.J. van Ingen Schenau (eds.), 719-723, Free University Press, Amsterdam,1988.

Sussman, D. H., Hamill, J., Miller, M. K. Effect of shoe height and prophylactic taping on ankle joint motion during simulated basketball rebounding. In Biomechanics XI-B, International Series on Biomechanics, G. deGroot, A.P. Hollander, P.A. Huljing, G.J. van Ingen Schenau (eds.), 826-830, Free University Press, Amsterdam, 1988.

Hong, D. M., DeVita, P., Hamill, J. Effects of assymmetrical load carrying on ground reaction forces during walking. In Proceedings of the XIIth International Congress of Biomechanics, RJ Gregor, RF Zernicke, WC Whiting (eds.), 59, University of California, Los Angeles, 1989.

Hamill, J., Bates, B. T., Knutzen, K. M. Arch index and kinematic lower extremity measures. In Proceedings of the XIIth International Congress of Biomechanics, R.J. Gregor, R.F. Zernicke, W.C. Whiting (eds.), 396, University of California, Los Angeles, 1989.

Boda, W. L., Hamill, J. Analysis of the initiation of backward rotations in diving. In Proceedings of the First IOC World Congress on Sports Science, 326-327, Colorado Springs, CO, October, 1989.

Hamill, J., Freedson, P. S., Braun, B., Clarkson, P. M. Muscle soreness and the oxygen cost of running. In Proceedings of the First IOC World Congress on Sports Science, 81-82, Colorado Springs, CO, October,1989

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Kandle, R., Whittlesey, S. N., Hamill, J. Gait adaptations in ACL-reconstructed patients before and after operative reconstruction. XVIIIth Congress of the International Society for Biomechanics in Sports, ETH Zurich, Switzerland, July, 2001.

National:

Knutzen, K. M., Bates, B. T., Hamill, J. Electrogoniometric evaluation of knee brace influences on the surgically repaired knee during overground running. American Alliance for Health, Physical Education, Recreation and Dance Annual Meeting, Minneapolis, MN, April, 1982.

Hamill, J., Knutzen, K. M. Evaluation of strapping techniques using ground reaction force data. American Alliance for Health, Physical Education, Recreation and Dance Annual Meeting, Anaheim, CA, April, 1984.

Sussman, D. H., Hamill, J. Effect of high and low top basketball shoes on sub-talar pronation. American Alliance for Health, Physical Education, Recreation and Dance Annual Meeting, Cincinnati, OH, April, 1986.

Hetzler, R., Knowlton, R. G., Hamill, J., Noakes, T., Schneider, T. Physiological and biomechanical comparison of able-bodied persons to wheel-chair dependent persons during wheelchair ergometry. American Alliance for Health, Physical Education, Recreation and Dance Annual Meeting, Cincinnati, OH, April, 1986.

Sussman, D. H., Hamill, J., Miller, M., Hong, T. Effect of shoe height and athletic taping on sub-talar joint supination during lateral movement. Annual Meeting of American Alliance for Health, Physical Education, Recreation and Dance, Las Vegas, NV, April, 1987.

Ricard, M. D., Hamill, J. Mechanical energy in the front handspring-front salto vault. American Alliance for Health, Physical Education, Recreation and Dance Annual Meeting, Kansas City, MO, April, 1988.

Greer, N. L., Hamill, J., Campbell, K. R. Ground reaction forces in children's gait. American Society of Biomechanics Annual Meeting, Champaign-Urbana, IL, September, 1988.

Ebbeling, C. J., Foti, T. A., Hamill, J., Ward, A., Rippe, J. Comparison of energy cost and lower extremity mechanics of three stair-stepping machines. American Alliance for Health, Physical Education, Recreation and Dance Annual Meeting, San Francisco, CA, April, 1991.

Holt, K. G., Jeng, S. F., Ratcliffe, R., Hamill, J. Optimality criteria in walking. Tenth Annual Meeting, International Society for Ecological Psychology, Hartford, CT, October, 1991.

Hamill, J., Bates, B. T., Holt, K. G. Timing of the knee and sub-talar joint actions during treadmill running. American Society of Biomechanics Annual Meeting, Phoenix, AZ, October, 1991.

Holt, K. G., Jeng, S. F., Ratcliffe, R., Hamill, J. Exploring the use of non-linear dynamics in the assessment of stability of human walking. 13th Annual Conference IEEE, Engineering in Medicine and Biology, Orlando, FL, November, 1991.

Holt, K. G., Jeng, S. F., Ratcliffe, R., Thompson, S., Hamill, J. Stability and the metabolic cost of human walking. XIth International Symposium on Posture and Gait: Control Mechanisms, Portland, OR, May, 1992.

Li, L., Hardin, E. C., Caldwell, G. E., Hamill, J. Comparison of walking and running at the same speed. American Alliance for Health, Physical Education, Recreation and Dance Annual Meeting, Atlanta, GA, April, 1996.

Li, L., Hardin, E. C., Van Emmerik, R. E. A., Caldwell, G. E., Hamill, J. Change in variability during prolonged downhill running. Biomechanics and Neural Control of Movement IX, Engineering Foundation Conference, Mt. Sterling, OH, June, 1996.

Worthen, L., Hamill, J. Biomechanical issues in ballet: ankle alignment in pointe shoes. 15th Annual Symposium on Medical Problems of Musicians and Dancers, Aspen, CO, June, 1997.

Li, L., Heiderscheit, B. C, Caldwell, G. E., Hamill, J. Knee joint stiffness during the stance phase of level running. Annual Meeting of the Combined Sections of the American Physical Therapy Association, Boston, MA, February, 1998.

Heiderscheit, B. C., Hamill, J., van Emmerik, R. E. A. Influence of Q-angle on lower extremity segment interactions during ruuning. Annual Meeting of the North American Society of Gait and Clinical Movement Analysis, San Diego, CA, April, 1998.

Kandle, R., Heiderscheit, B.C., Hamill, J. Interjoint coordination following ACL reconstruction. Annual Meeting of the Combined Sections of the American Physical Therapy Association, New Orleans, LA, February, 2000.

Haddad, J., van Emmerik, R. E. A., Whittelsey, S.N., Hamill, J. Inter- and intra-limb coordination under asymmetrical loading. American Alliance for Health, Physical Education, Recreation and Dance Annual Meeting, Orlanda, FL, March, 2000.

Regional, State, and Local:
Hamill, J. A comparison of selected kinematic parameters in the support phase of running on various inclinations. Conference of the Oregon Alliance for Health, Physical Education, Recreation and Dance, October, 1980.

Hamill, J., Knutzen, K. M., Sawhill, J. A. Accuracy for center of gravity estimates. Conference of the Oregon Alliance for Health, Physical Education, Recreation and Dance, October, 1980.

Hamill, J., Bates, B. T. Effects of shoe-orthotic interactions. New England Chapter of the American College of Sports Medicine Annual Meeting, Foxboro, MA, November, 1986.

Boda, W. L., Hamill, J., Homa, K. Shoe type and lower extremity kinematics during walking. New England Chapter of the American College of Sports Medicine Annual Meeting, Worcester, MA, November, 1988.

Holt, K. G., Hamill, J., O'Connor, D. Perceived and biomechanical evaluation of orthotic inserts. New England College Chapter of the American of Sports Medicine Annual Meeting, Worcester, MA, November, 1988.

Ebbeling, C. J., Hamill, J., Foti, T., Ward, A, Rippe, J. Kinematics of the lower extremity on stair-stepping machines. New England Chapter of the American College of Sports Medicine Annual Meeting, Marlborough, MA, November, 1990.

Hintermeister, R. A., Hamill, J. Is symmetry valid in running? New England Chapter of the American College of Sports Medicine Annual Meeting, Marlborough, MA, November, 1990.

Boda, W. L., Hamill, J. Kinematic variations in three different backward presses in springboard diving. New England Chapter of the American College of Sports Medicine Annual Meeting, Marlborough, MA, November, 1990.

Elliott, E. H., Hamill, J., Derrick, T. R. Reliability of the LiftStation measurement system. New England Chapter of the American College of Sports Medicine Annual Meeting, Boxborough, MA, November, 1993.

Derrick, T. R., Hamill, J., Foti, T. Spectral analysis of EMG during running in orthotic/non-orthotic conditions. New England Chapter of the American College of Sports Medicine Annual Meeting, Boxborough, MA, November, 1993.

Elliott, E. H., Hamill, J., Derrick, T. R. The influence of multiple lifts on load kinematics in males and females. New England Chapter of the American College of Sports Medicine Annual Meeting, Boxborough, MA, November, 1994.

Mahar, A., Hamill, J., Derrick, T. R. Impact attenuation during running. New England Chapter of the American College of Sports Medicine Annual Meeting, Boxborough, MA, November, 1994.

Li, L., Swanson, S. C., Caldwell, G. E., Hamill, J. Measurement of lower extremity stiffness during the stance phase of level and downhill walking. New England Chapter of the American College of Sports Medicine Annual Meeting, Boxborough, MA, November, 1995.

Swanson, S. C., Derrick, T. R., Hamill, J. Impact attenuation and forefoot stiffness in hiking boots. New England Chapter of the American College of Sports Medicine Annual Meeting, Boxborough, MA, November, 1995.

Hardin, E. C., Hamill, J., Taylor, J. M. The influence of midsole durometer on leg shock, hemocrit and muscle damage during downhill running. New England Chapter of the American College of Sports Medicine Annual Meeting, Boxborough, MA, November, 1995.

Heiderscheit, B. C., Hamill, J., Derrick, T. R. Relationship between Q-angle and lower extremity kinematics during running. Annual Conference of the Massachusetts Chapter of the APTA, Danvers, MA, October, 1996.

Busconi, K., Gore, M., Hamill, J., Freedson, P. Time motion profile of U. S. Olympic field hockey players during game conditions. New England Chapter of the American College of Sports Medicine Annual Meeting, Boxborough, MA, November, 1996.

Heiderscheit, B. C., Hamill, J., Derrick, T. R. Relationships between Q-angle and lower extremity kinematics. New England Chapter of the American College of Sports Medicine Annual Meeting, Boxborough, MA, November, 1996.

Goff, D., Hamill J., Clarkson, P. Biomechanical and biochemical changes after downhill running. New England Chapter of the American College of Sports Medicine Annual Meeting, Providence, RI, September, 1997.

KEYNOTE PRESENTATIONS

Mechanics of tower dive take-offs. United States Diving Association Annual Convention, Phoenix, AR, September, 1985.

Mechanics of walking. National Prescription Footwear Association, New York, NY, November, 1987.

Athletic Footwear and Injury. American Public Health Annual Meeting, Boston, Massachusetts, November 15, 1988.

Biomechanics of the lower extremity. Southeast Chapter of the American College of Sports Medicine Annual Meeting, Louisville, Kentucky, February 2, 1991.

Timing of lower extremity joint actions: A mechanism for knee injury? Northwest Chapter of the American College of Sports Medicine Annual Meeting, Eugene, OR, February 11, 1993.

Running injuries and rehabilitation. International Society of Biomechanics in Sports Annual Meeting, Budapest, Hungary, June 5, 1994.

Biomechanical aspects of exercise in children. IXth Annual NASPEM Conference, Pittsburg, PA, August 12, 1994.

Evaluation of athletic footwear using ground reaction force data. International Society of Biomechanics in Sports Annual Meeting, Madiera, Portugal, June, 1996.

Biomechanics of distance running. International Symposium of the Research Institute of Sports Science at Korean National University, Seoul, Korea, October 17, 1997.

Evaluation of shock attenuation. Fourth Symposium of the Technical Group on Footwear Biomechanics, Canmore, Alberta, Canada, August 6, 1999.

INVITED PRESENTATIONS

Effects of running shoes on foot function. Y.M.C.A., Eugene, OR, October, l981.

Medio-lateral foot function during locomotion. University of Illinois Graduate Faculty and students, Champaign, IL, February, l983.

Biomechanics of walking. American Heart Association Walk for Life, St. Louis, MO, May, l987.

Biomechanics of walking and running shoes. New Mexico Race Walkers Association, Albuquerque, New Mexico, June, l987.

Biomechanics of fitness walking. American Diabetes Association, St. Louis, Missouri, September, 1987.

Orthotics and lower extremity function. Athletic Training Symposium, American Alliance for Health, Physical Education, Recreation and Dance Annual Meeting, Kansas City, Missouri, April, 1988.

Running analysis from both a biomechanical and physiological perspective. Symposium, New England College of Sports Medicine Annual Meeting, Worcester, MA, November 4, 1988.

If the shoe fits: A biomechanical analysis of locomotion. Sigma Xi Society, University of Massachusetts, Amherst, MA, November 16, 1988.

Muscle soreness during running: Biomechanical and physiological considerations. Neuromuscular Research Center Seminar, Boston University, September 20, 1989.

Design of athletic shoes : Biomechanical considerations. Kinesiology Academy Meeting at the American Alliance of Health, Physical Education, Recreation, and Dance Annual Meeting, New Orleans, LA, April 28, 1990.

Biomechanical implications of the design of running shoes. Physical Therapy Department, Boston University, April 18, 1990.

Biomechanics of running. Physical Therapy Department, Boston University, November 6, 1990.

Is biomechanics an atheoretical discipline? Kinesiology Academy Teaching Conference, Ames, Iowa, July 5, 1991.

Biomechanics of Running. Education Resources Inc. Conference, Framingham, MA, September 27, 1991.

Optimality criteria for human locomotion. Motor Control/Biomechanics Seminar, Department of Exercise and Human Movement Studies, University of Oregon, January, 1992.

Biomechanical considerations for equipment design in children's sports. Seminar on Children's Activities, United Hospital Medical Center, Port Chester, NY, March 28, 1992.

Effficency of children's gait. (with C. J. Ebbeling). Kinesiology Academy Symposium at the American Alliance of Health, Physical Education, Recreation, and Dance Annual Meeting, Indianapolis, IN, April 13, 1992.

Optimality criteria for human locomotion. (with Holt, K. G., Maliszewski, A. F.) Invited Symposium at the Annual Meeting of the American College of Sports Medicine, May, 1992.

Optimality criteria for human locomotion. (with K. G. Holt and A.F. Maliszewski). Symposium at the American College of Sports Medicine Annual Meeting, Seattle, Washington, June 5, 1993.

The influence of step aerobics on knee angle. Research Symposium at the IDEA Annual Conference, New Orleans, Louisiana, June 21, 1993.

Rearfoot motion in running. (with K. G. Holt and C. J. Edington). Symposium at the New England College of Sports Medicine Annual Meeting, Boxborough, MA, November 5, 1993.

Controversies in the calculation of mechanical energy. (with K. D. Browder and L. Darby). Biomechanics Academy Symposium at the American Alliance of Health, Physical Education, Recreation, and Dance Annual Meeting, Denver, CO, April 13, 1994.

Stability and rearfoot motion testing: A proposed standard. (with M. Milliron and J. Healy). VIIIth Biennial Meeting of the Canadian Society for Biomechanics, Calgary, Canada, August, 1994.

Stride Frequency and Foot Strike Impact. Dept. of Exercise and Sports Science. Arizona State University, December 8, 1994.

Biomechanics of functional footwear. (with M. Shorten). Pre-Conference Symposium at the International Society of Biomechanics Biannual Meeting, Jyvaskyla, Finland, June, 1995.

Impact shock attenuation during conditions of altered stride frequencies in running. (with T. R. Derrick and K. G. Holt). Biomedical Engineering Society Meeting, Boston, MA, October, 1995.

Shoe and surface influences on ACL injuries. (with B. Busconi). American Volleyball Coaches Annual Meeting, Springfield, MA, December 15, 1995.

A force-driven harmonic oscillator model of human locomotion. German Sports University, Cologne, Germany, February 29, 1996.

If the shoe fits: the biomechanics of running shoes. American Medical Athletic Association, Boston, MA, April 12, 1996.

Biomechanics of athletic footwear. (with Martyn Shorten). American Alliance of Health, Physical Education, Recreation, and Dance Annual Meeting, Atlanta, GA, April, 1996.

An oscillator model of locomotion. University of Massachusetts Physics Department Seminar, Amherst, MA, May 1, 1996.

The mechanics of orthotics. New England Chapter of the American College of Sports Medicine Annual Meeting, Boxborough, MA, November 7, 1996.

A case study of a patient with patellofemoral pain. Eugene Michaels Lecture at the Combined Sections Meeting of the American Physical Therapy Association Annual Meeting, Dallas, Texas, February 14, 1997.

Oscillator Models of Human Locomotion. Korean Sports Science Institute, Seoul, Korea, October 15, 1997.

Lower extremity variability during running. Physical Therapy Department Seminar, University of Delaware, February 20, 1998.

Shock attenuation and transmission during running. (with T. R. Derrick). XVIIth Congress of the International Society of Biomechanics, Calgary, Alberta, Canada, August 12, 1999.

Variability and Stability: A Dynamical Systems Perspective. (with Van Emmerik, R. E. A., Heiderscheit, B., Li, L). Invited Symposium at the Annual Meeting of the American College of Sports Medicine, Indianapolis, IN, June, 2000.

From a Pendulum to a Spring. Department of Kinesiology, Louisiana State University, Baton Rouge, LA, October 24, 2000.

Oscillators and Springs. The Gladys Garrett Honor Lecture, Department of Exercise Science, University of Connecticut, Storrs, CT, May, 2001.

Joint Coupling variability and knee pain during running. (with B. Heiderscheit, R. Van Emmerik, J. Haddad). XVIIIth Congress of the International Society of Biomechanics, ETH Zurich, Switzerland, July, 2001.

GRANTS AND GIFTS

1. Mechanics of lower extremity function, Isotechnologies, Inc., $12,000, 9/82 - 6/84.

2. Dynamics of platform diving, United States Diving Association, $3,000, 1/84 - 12/84.

3. Effects of anatomically variant foot-types on walking gait, ORDA, Southern Illinois University, $6,000, 9/85 - 6/86.

4. Ergonomics of lower extremity function, KangaROOS, USA, $58,000, 9/86 - 9/89.

5. Effect of orthotic inserts on walkers with rearfoot and forefoot dysfunctions. Biomedical Research Support Grant, $6,000, 1/87 - 1/89.

6. Activity in later life: effects on posture and gait. National Institute of Aging, co-principal investigator, resubmitted January 28, 1988 (approved but not funded).

7. Musculoskeletal fitness norms for individuals aged 45-75. National Institute of Health, submitted February 1, 1988 (approved but not funded).

8. Prophylactic Knee and Ankle Bracing, AirCast Corp., $20,000, 9/88 - 9/89.

9. Mechanics of springboard diving : modeling the diver-board system, United States Diving Association, $15,000, 1/89 - 1/91.

10. Lower extremity action during exercise, Life-Fitness Group, $6,000, 7/90 - 7/92.

11. Biomechanical analysis of military boots, (Contract #DAAK60-91-C-0102) U.S. Army, Natick, MA, $183,000, 7/1991 - 12/1992.

12. Lower extremity mechanics, Hyde Athletic Shoe Company, $279,000, 1/89 - 1/97.

13. Biomechanical analysis of golf equipment, Titlest and Footjoy Worldwide, $283,000, 6/92-12/97.

14. Biomechanical analysis of hiking gait, The Timberland Company, $15,000, 3/95 - 10/95.

15. Biomechanical analysis of military boots, (Contract #DAAK60-95-R-8010) U.S. Army, Natick, MA, (sub-contract from Wellco Industries, North Carolina, $51,436, 9/1995 - 12/1997.

16. A physiological profile of the game of field hockey. (with P. S. Freedson). United States Olympic Committee, Colorado Springs, Colorado, $35,132, 1/1996 - 12/1996.

17. Locomotor patterns on running machines. NordicTrak, $10,000, 9/97-3/98.

18. A prospective study of running injuries: variability in movement coordination. (with R. van Emmerik). National Institute of Health, submitted October 1, 1997.

19. Plantar pressure patterns during hiking gait. The Timberland Company, $42,000, 3/98 - 5/99.

20. Investigation of foot scaling using a 3-D laser measurement system. Titleist and FootJoy Worldwide, $50,000, 1/99 – 12/00

21. Biomechanical analysis of golf footwear, Titleist and FootJoy Worldwide, $63,000, 1/99-12/99.

22. Walking and running mechanics and their effect on footwear, Hyde Athletic Shoe Company, $33,000, 1/99 - 12/99.

23. In-shoe temperatures during hiking, The Timberland Company, $15,000, 1/99-3/99.

24. Plantar forces during basketball movements, And1 Company, $15,000, 1/99-3/99.

25. Rearfoot motion and shock attenuation in trial running footwear, The Timberland Company, $10,000, 6/99-7/99.

26. Biomechanical analysis of military boots: Phase III, (Contract #DAAK60-95-R-8010) U.S. Army, Natick, MA, (sub-contract from Wellco Industries, North Carolina, $5,000, 9/1999 - 12/1999.

27. Biomechanical analysis of military boots. (Contract #DAAK16-00-P-0112) U.S. Army Soldier Systems Center, Natick, MA, $25,000, 1/2000 - 6/2000.

28. Implementation of a 3-D laser measurement system. Titleist and FootJoy Worldwide, $89,000, 1/2000 – 12/2000.

29. Shock attenuation in hiking footwear, The Timberland Company, $18,000, 1/1/2000 - 6/31/2000.

30. Traction analysis of golf footwear, Titleist and FootJoy Worldwide, $48,000, 1/2000 - 12/2000.

31. Prospective study on tibial stress fractures. (with Irene McClay). US Army, $1,050,000, 8/1/2000 – 8/1/2004.

32. Footwear Testing, Titleist and FootJoy Worldwide, $50,000, 1/2001 - 12/2001.

33. 3-D laser measurement system. Titleist and FootJoy Worldwide, $89,000, 1/2001 – 12/2001.