



Annual Fundraising Dinner

by Rich Debski and Serena Chan Saw



Dr. Thay Lee, Ms. Erin McGurk, Dr. Pat McMahon, Mrs. Kazuko Mizuno, Mrs. Pattie Woo, Dr. Savio L-Y. Woo, Dr. Kosaku Mizuno, Dr. Morey Moreland, and Dr. Johnny Huard at the Fundraising Dinner.

The ORLAC annual fundraising dinner was held at Pasta Al Dente in Long Beach California on February 1, 1999 during the Orthopaedic Research Society meeting. It was an enjoyable evening that consisted of great food, fine wine, and excellent conversation. The restaurant staff was quite accommodating (since we took over the entire restaurant) and served us many courses of Italian food. During the course of dinner, the contributions of many people were recognized including Dr. and Mrs. Savio L-Y. Woo for another generous donation that will be used towards increasing the amount of grant money available to students, Drs. Thay Lee and Pat McMahon for arranging the fabulous meal, and Dr. Glen Livesay for his hard work at putting together our first web page. In addition, students that received research

grants were able to meet the people that made their funding possible. Due to the dinner's close proximity to San Diego, some ORLAC members attended dinner even though they were not attending the ORS meeting.

Karen Ohland served as the Master of Ceremonies for the evening and oversaw the yearly introduction of dinner attendees. Special guests included Dr. and Mrs. Mizuno. Dr. Mizuno is from Kobe University in Kobe, Japan and is the professor of Drs. Kotaro Nishida and Masayoshi Yagi, two current fellows at the MSRC.

ORLAC Board Update

ORLAC would like to welcome Caroline Wang, MS to the Board of Directors. Caroline received her Master's degree in 1989 while working with Dr. Woo at UCSD. Caroline has also accepted the position of Secretary. In addition, Ted Rudy, MA has become the Assistant Treasurer and Karen Ohland, MS has assumed the position of Fundraising Chairperson. Congratulations to all on your new duties!!

ORLAC would also like to announce that we now have our very own website. Thanks to the hard work of Glen Livesay, PhD, our official webmaster, our organization is located at <http://www.orlac.org>

Be sure to check out our new website at <http://www.orlac.org>

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ORLAC Summer Grant Recipients

Compiled by Serena Chan Saw



1998 ORLAC summer awardee Marsie Janaushek, B.S. with her advisor, Dr. Savio L-Y. Woo

We are happy to include the following reports from ORLAC Summer Grant Recipients. Jamie Pfaeffle, who recently defended his PhD under the guidance of Dr. Savio L-Y. Woo, received the 1997 Mrs. Ho-Tung Cheong Research Grant for a graduate student to visit an alumnus' laboratory to perform musculoskeletal research. Jamie traveled to Dr. Jeff Weiss' laboratory in Salt Lake City, Utah and performed research that was incorporated into his PhD thesis.

Marsie Janaushek is a masters student working with Dr. Woo at the Musculoskeletal Research Center at the University of Pittsburgh and plans to complete her work this summer. She was awarded the Erin McGurk Research Grant for 1998 which is designated for a female graduate student to perform musculoskeletal research. Her project was entitled "Variables of PCL Reconstruction: Effect of Knee flexion angle and tibial position at the time of graft fixation on the outcome of a PCL reconstruction".

Michael J. Araj was awarded the Mr. & Mrs. Kwok-Chong Woo Research Grant which was designated for an undergraduate student to perform musculoskeletal research during the summer of 1998. He spent his summer working with Dr. Jennifer Wayne at the Orthopaedic Research Laboratory at Virginia Commonwealth University. His

project included work on a computer model of cartilage under different loading conditions.

The third awardee for 1998 was John Gardiner, a PhD student working with Dr. Jeff Weiss in Utah (although Jeff has since moved to Arizona). John received the Mrs. Ho-Tung Cheong Research Grant and has decided to visit Dr. Savio Woo and the Musculoskeletal Research Center at the University of Pittsburgh in May. We will have an update of his work in the next newsletter. Following are the summaries of the research performed by Jamie, Marsie and Michael.

Jamie Pfaeffle

I was honored to receive this fellowship from ORLAC in the summer of 1997. In the spring of 1998, after much advance planning, I traveled to the Orthopaedics Biomechanics Institute (OBI) at the Orthopaedic Specialty Hospital in Salt Lake City Utah. There I was fortunate enough to have an opportunity to study under the guidance of Dr. Jeffrey Weiss for six weeks. I went there with the

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Newsletter Publisher

Serena Chan Saw, MS

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STUDENTS TAKE NOTE!!!



1999 ORLAC Summer Research Grants Program

by Jennifer Wayne

Once again, we are able to offer three opportunities for graduate and undergraduate students alike, from the United States and abroad, that you won't want to miss! ORLAC continues its Summer Research Grants Program for 1999 to foster musculoskeletal research among students studying in the labs of ORLAC participants. What a great way to recognize creative endeavors of the very important members of our laboratories!

And it is really easy to apply for one of the three awards. An application consists of the following:

- 1) Name of specific award, your address, and other contact information
- 2) A one page description of the objectives including a description of the project
- 3) Transcript (applicant must be a student during award period)
- 4) Resumé
- 5) Letter of recommendation from a faculty or industry member
- 6) Budget for the designated amount
- 7) Mail all application materials to:

**ORLAC
Summer Research Grants Program
P.O. Box 7511
Pittsburgh, PA 15213**

The three grants and their specifications are:

The Mr. & Mrs. Kwok-Chong Woo Grant

Designated for an undergraduate student to perform musculoskeletal research during the summer of 1999. Maximum budget of \$3,000.

The Mrs. Ho-Tung Cheong Grant

Designated for a graduate student to visit an alumnus laboratory and participate in musculoskeletal research at the host laboratory. At the time of application, the host laboratory must be named. Maximum budget of \$3,000.

The Erin McGurk Grant

Designated for a female graduate student to perform musculoskeletal research during the summer of 1999. Maximum budget of \$2,500.

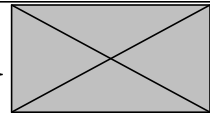
The application deadline for the awards is **May 7, 1999.**

The awardees and their mentors will be contacted by phone and mail by May 28. Checks for the designated amount of the specific award will be made out to the laboratory in which the work is to be conducted, with the understanding that the funds are to be used in support of the awardee's research.

That's all there is to it. So, what are you waiting for? - to have a great summer in research!

If you have any questions, please contact Rich Debski at (412) 648-1638 or genesis1+@pitt.edu.

News from Around the World



Compiled by Glen Livesay, Serena Chan Saw and Jennifer Wayne

Doug Boardman, MD (MSRC) is currently completing a 2 year fellowship in upper extremity in the Mayo Clinic in Rochester, MN while also performing research under the guidance of Dr. Kai-Nan An.

Greg Carlin, MS (MSRC) is attending law school at George Washington University in Washington, D.C. He is specializing in patent law and plans to graduate in 2000. Greg also is getting married this May.

Drs. Marcus and Minoo Hollis' (UCSD) have added a little girl to their growing family. Leila Hollis was born on June 15, 1998.

Glen Livesay, PhD (UCSD & MSRC), recently moved to New Orleans to become an Assistant Professor in the Department of Biomedical Engineering at Tulane University. He has settled into his apartment where his wife Maki will join him in May after her tenure in the Air Force.

Deidre MacKenna, PhD (UCSD), is now working for Tanabe Research Laboratories, USA. She is a Research Scientist at TRL which specializes in drug discovery.

David Provenzano, MD (MSRC), is about to graduate from University of Rochester with a degree in medicine and will begin a residency in Orthopaedic Surgery at Thomas Jefferson Hospital in Philadelphia, PA.

Tom Runco, MS (MSRC) is currently working in Philadelphia as an engineer for Synthes Spine, designing implants, performing mechanical analyses, and interfacing with surgeons for the surgical treatment of spine trauma, deformity, & degeneration, as well as tumor and neuromuscular problems. Tom also, has 6 adorable nephews & nieces, from 6 weeks to 6 years of age, back home in Pittsburgh.

Jeff Weiss, PhD (UCSD) began a new faculty position at University of Arizona in October 1998. He joins the new Biomedical Engineering interdisciplinary program, with secondary appointments in the Departments of Aerospace and Mech-

anical Engineering and Orthopedics. Dr. Weiss was an invited participant to the 5th Japan-USA-Singapore-China Conference on Biomechanics in Sendai, Japan.

Caroline Wang, MS (UCSD) continues to expand her family network with the addition of a baby girl, Sasha Caroline born on 10/19/98. Her husband Mike has started another company, this one concentrated on web search engines. Mike and the company were featured recently in Inc. Magazine.

John Xerogeanes, MD (UCSD/MSRC) is currently working as a sports medicine fellow at the Steadman-Hawkins clinic in Vail, CO.

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Currently, at the Orthopaedic Research Laboratory at Virginia Commonwealth University:

Jennifer Wayne, PhD (UCSD) was promoted and tenured to Associate Professor of Biomedical Engineering at Virginia Commonwealth University this past summer. She was an invited participant at two international conferences, 5th Japan-USA-Singapore-China Conference on Biomechanics in Sendai Japan and the Biot Conference on Poromechanics in Belgium. She also was inducted into the Hall of Honor at her high school in New Jersey. She is the Bioengineering Division Program Representative to the 1999 International Mechanical Engineers Conference & Exposition of ASME.

Three new members have been added to Dr. Wayne's research laboratories. **Charles (Ted) Shuff MD** and **Mark Willis MD** are research fellows, **John Owen** joins the lab as rehabilitation engineer after 15 years of experience with Phillip Morris.

On the personal side, Dr. Wayne's two daughters are well - Stephanie started kindergarten and Nancy began in preschool this year. Her husband Gene continues to travel around the globe, expanding his company's applications for their specialty fibers.

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Can you identify the people in this picture?

Currently, at the VAMC Long Beach/Univ. Cal Irvine Orthopaedic Biomechanics Laboratory:

The OBL received two VA Rehabilitation R&D Awards for three years each. The first is titled "Biomechanics of the Patellofemoral Joint" with the investigators being **Thay Lee, Pat McMahon, WC Kim, SH Anzel and HB Skinner**. The second is titled "Biomechanics of the Glenohumeral Joint in Spinal Cord Injury Patients" with the investigators being **Thay Lee, Pat McMahon, SH Anzel, WC McMaster, J Yu**.

Jonathan Woo joined **Matthew D. Sandusky** and **Bruce Y. Yang** as a staff member at the OBL and is attending Cal. State University, Long Beach.

Fritz E. Glaser, MD and **Thay Q Lee, PhD** were awarded the "Vernon P. Thomson Award" from the Western Orthopaedic Association for a paper entitled "Edge Loading of the Patellar Components Following Total Knee Arthroplasty".

New members at OBL include **Arshya Adelli**, an undergraduate student, a medical student, and orthopaedic residents **Vance Eberly, MD, Scott Graham, MD, Steven Barnett, MD, Chris**

Yeung, MD, Derek Dee, MD, Rick Scintalan, MD, Steven Chow, MD.

Todd A. Shapiro is graduating from Chicago Med and will be starting Orthopaedic Residency at UCI in July. Todd has been a part of the OBL since 1993.

Thay Lee received a PhD in Biomaterials from Gothenburg University, in Gothenburg Sweden. His advisor was Tomas Albrektsson, MD, PhD. Professor and Chair of the Department of Biomaterials and Handicap Research. His

thesis was titled "Biomechanics of the Patellofemoral Joint and Patellar Resurfacing in Total Knee Arthroplasty". Thay can now be officially addressed as Dr. Lee.

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Currently, at the Musculoskeletal Research Center at the University of Pittsburgh:

Richard E. Debski, PhD, and the Shoulder Group were awarded a \$20,000 grant this year from the American Shoulder and Elbow Society, for their proposal entitled "A Biomechanical Analysis of AC Joint Function." In addition, the Arthroscopy Association of North America awarded \$19,000 to **Akihiro Kanamori, MD, Christopher D. Harner, MD**, and the PCL Group for their project, "Biomechanical Analysis of a Double Bundle PCL Reconstruction." Perhaps most exciting was the supplemental grant awarded by the NIH to graduate student **Jorge Gil, BS**, in September. The award provides \$78,000 to support Mr. Gil's graduate research in the ACL Group and will also cover his tuition and stipend for the next three years.

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News Around the World (cont'd)



Rich Debski, PhD and Pat McMahon, MD at this year's annual fundraising dinner.

Undergraduate student **Louis DeFrate**, received a prestigious honor this year. Lou, a senior mechanical engineering student who has spent three semesters at the MSRC as a co-op student was named a University Scholar, by the University of Pittsburgh. This honor is awarded to only the top 2% of all students at Pitt each year!

In November, 1998, graduate students **Maria Apreleva, MS, Tracy Vogrin, MS, and Jorge Gil, BS**, accompanied by faculty member **Richard Debski, PhD**, represented the MSRC at the Student Paper Competition of the American Society of Mechanical Engineers Winter Meeting in Anaheim, California. Maria and Tracy presented their respective thesis work, with Maria finishing 3rd in the Ph.D. level competition and Tracy finishing 1st at the M.S. level. To complete a clean sweep for the MSRC, Jorge won the 2nd place award at the B.S. level for his work on a rigid body spring model of the knee.

Kotaro Nishida, MD and the Spine Group, under the direction of **Lars Gilbertson, PhD, and James Kang, MD**, received an award for best basic science paper from the Volvo Company of Goteborg, Sweden, in association with the International Society for the Study of the Lumbar Spine (ISSLS) for their paper, entitled "Modulation of the Biological Activity of the Rabbit Intervertebral Disc by Gene Therapy: An In-Vivo Study of

Adenovirus-Mediated Transfer of the Human TGF- β 1 Encoding Gene." co-authored by **Dr. Nishida, Dr. Gilbertson, Dr. Kang, Dr. Chris Evans, Dr. Paul Robbins, Dr. Seong-Hwan Moon, Dr. J.K. Suh, and Dr. Molly Vogt**. The award will be given to the group in June at the ISSLS Meeting in Kona, Hawaii and the full length paper will be published in the Spine Journal.

Savio L-Y. Woo, PhD, DSc was honored by the University of Pittsburgh with a special award, the Chancellor's Distinguished Researcher Award in the Senior Scholar category for "outstanding and continuing record of research and scholarly activity". The honor included a check in the amount of \$5,000. In addition, this past year, Dr. Woo was named the president of the World Congress of Biomechanics for a four year term.

The PCL group was given the Cabaud Award for basic science research from the American Orthopaedic Society for Sports Medicine. The project, entitled "Biomechanical Analysis of a Double Bundle Posterior Cruciate Ligament Reconstruction: Comparison with a Single Bundle Reconstruction" was co-authored by **Dr. Christopher Harner, Marsie Janaushek, Dr. Akihiro Kanamori, Dr. Masayoshi Yagi, Tracy Vogrin, and Dr. Savio Woo**. The paper will be presented by Dr. Harner at the annual meeting of the AOSSM in Traverse City, Michigan, in June, 1999. This marks the second time in five years that the PCL group has won a research award from the AOSSM. Our research fellow **Christos Papageorgiou, MD**, of Greece and the ACL Group were awarded the Albert Trillat Young Investigator's Award from the International Society of Arthroscopy, Knee Surgery, and Orthopaedic Sports Medicine (ISAKOS). The paper, entitled "Biomechanical Interdependence Between the ACL Replacement Graft and the Medial Meniscus" was co-authored by **Jorge Gil, Dr. Akihiro Kanamori, Dr. Jim Fenwick, Dr. Freddie Fu, and Dr. Savio Woo**, and will be presented at the ISAKOS Meeting in May. On the same day, Dr. Papageorgiou and **Jacques Menetrey, MD**, were chosen as Travelling Fel-

lows by the European Society for Sports Medicine, Knee Surgery and Arthroscopy (ESSKA). They will be touring orthopaedic programs in Asia and the U.S., respectively.

Jamie Pfaeffle, PhD, an MD/PhD student at the University of Pittsburgh, defended his dissertation this summer and has returned to life as a third year medical student. However, Jamie remains active with the Upper Extremity Group, Two days later, **Ted Manson, MS**, also of the Upper Extremity Group, completed his Master's degree this summer and soon began his first year at Northwestern Medical School. Finally, **Ted Clineff, MS** of the MCL group, successfully defended his Master's thesis in March and has returned to his roots in Eastern Pennsylvania with his wife Amy to pursue a career in industry.

During this past year we have welcomed many new faces to the MSRC. James H-C. Wang, Ph.D. joined the MSRC in September, 1998 as a research assistant professor working with the MCL group and assisting **Dr. David Stone** with the tendonitis project. James comes to us from the University of Washington, St. Louis along with his wife, Rongfei Wu and two children, Anlu and Anjie. **Ms. Colleen O'Hara, MEd**, joined the MSRC in December, 1998 as the new secretary and receptionist.

Two new post-doctoral research fellows joined us this year. **Masayoshi Yagi, MD** from Japan and **Seong-Hwan Moon, MD** from Korea are both here for two year fellowships.

We have added 5 new graduate students this past year: **Steven Abramowitch, BS** from the University of Pittsburgh, **Mary Gabriel, BS** from Case Western Reserve University, **Jonathan Sakai, BS** from the University of Dayton, **Kathryne "Kitty" Stabile, BS** from the Michigan State University, and **Al Vangura, Jr., BS**, from Penn State University but more recently from Hil-Rom Company in Batesville, Indiana. **Chris Celechovsky, BA** comes to us from Colorado and is spending the year with us while applying to medical school.

Ken and Sandie Fischer celebrated the birth of their 2nd daughter, Miranda May, in December. She joins her sister Kesandra.

Mary Gabriel, BS has announced her upcoming wedding in May, 1999 to her fiance, Adam.

Al Vangura, BS and his wife Vicki are expecting their first child in November.

Staff engineer, **Becky Engel, MS**, left the MSRC in August 1998 to return to her home state of Michigan and begin a career with Medtronic/DLP. Her husband, Jeff, is a chemical engineer with UpJohn Pharmaceuticals. They recently have purchased property and will begin building their new home in the spring. German medical student, **Sven Scheffler** also left in August 1998 to return to Berlin to complete his education.

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 • **If you have an address change or exciting news** •
 • **that you would like to share with ORLAC,** •
 • **please let Serena know by:** •
 • **Phone: (412) 648-2023, fax: (412) 648-2001 or** •
 • **email: chanss+@pitt.edu** •

Japan Symposium

by Karen Ohland

This past summer, prior to the Third World Congress of Biomechanics in Sapporo, Japan, several ORLAC members had the privilege of visiting Kyoto and participating in the Bioengineering Conference organized by Dr. Shinro Takai. The conference was held on July 31st, 1998 at Kyoto University in the Institute for Frontier Medical Sciences. After arriving at the Institute and exchanging our shoes for slippers, we were welcomed by Dr. Ken Ikeuchi. Dr. Ikeuchi is a mechanical engineer and has been a Professor at the Research Center for Biomedical Engineering since 1990. During our visit, which included a tour of several well equipped laboratories, we learned much about Dr. Ikeuchi's research and experiments in tribology, biomechanics of knee menisci and the use of medical robots for low invasive diagnoses, surgery and drug delivery systems.

Following opening remarks by Dr. Takai, the Bioengineering Conference began at 1:30pm (Kyoto time) with presentations on the "Biomech-

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Japan Symposium (cont'd)

anics of the Patellofemoral Joint and the Glenohumeral Joint”, by Thay Lee and Pat McMahon (U of California, Irvine), respectively. Lars Gilbertson’s (U of Pittsburgh) discussion of “Virtual Reality Assisted Measurement of Cervical Spine Kinematics” was followed by a talk on the “Practical Application of Acoustic Emission Technique for Bone Consolidation Problems” by Yoshinobu Watanabe (Kyoto Prefectural U. of Med.). Jun-Kyo Suh (U of Pittsburgh) described the “Development of GAG-Augmented Polysaccharide Hydrogel as a Carrier Substance for Chondrocyte Transplantation” prior to Naohide Tomita’s (Kyoto U) talk on the Biological and Mechanical Fixation of Artificial Ligaments. Karen Ohland (then with Howmedica) compared the “Effects of Ethanol Fixation vs. Fresh Freezing on the Torsional Properties of Ovine Tibiae” and then Nobuyuki Yoshino (Kyoto Prefectural U. of Med.) spoke on “Stress Analysis of Prosthetic Replaced Tibia”. In the final talk, Tetsuji Minoura (Kyoto U) presented “A Numerical Simulation Study for an Endovascular Balloon Occlusion for Cerebral Aneurysms”.

All speakers had the opportunity to receive feedback from an audience of international researchers. Dr. Savio L-Y. Woo gave the closing remarks, thanking all for participating and sharing their research and encouraging similar events to be held in the future.

Summer Awardees (cont'd)

goal of applying Dr. Weiss’s finite element implementation of his transversely isotropic material model for soft tissues to the ligament I had been studying since 1994.

The interosseous ligament (IOL) is a strong ligament that connects the radius and ulna in the central forearm. My thesis project was to develop experimental and theoretical models to help understand forces that arise in the IOL in response to compressive load applied to the hand. To this end, work in Pittsburgh involved experiments to load forearms in compression while measuring force

in the IOL and kinematics of the forearm bones. Additional work on reconstructing computer models of forearm geometry from computed tomography images and their use in theoretical analyses to predict planar stresses in the IOL was accomplished.

Armed with these data, I developed a plan with Dr. Weiss to take geometry, boundary conditions, and some IOL’s to Utah (along with my mountain bike and skis) with the intention of developing a finite element model of the IOL and measuring it’s material properties along and transverse to the fiber direction.

In Pittsburgh, a cadaveric forearm was subjected to computed tomography and an experiment to load the forearm in compression. The experiment was performed in pronation, neutral rotation, and supination. During the experiment, motions of the bones were recorded with a high accuracy digitization system accurate to 0.1 mm and 0.1 degrees. After testing, the central radius, ulna, and IOL were frozen for later material property tests. Custom software developed by Theodore Manson, a masters student at the MSRC in Pittsburgh, was used to reconstruct geometric models of the radius, ulna, and IOL on the computer.

In Utah, the first task was to construct a finite element mesh for the radius, ulna, and IOL using a SGI workstation computer. After meshing, kinematics of the radius and ulna from the unloaded to loaded state in all three rotation positions were expressed in a form using quaternion angles that is used in the finite element code. Much time was spent applying Dr. Weiss’s material testing techniques to measure material properties along and transverse to fiber direction. Custom punches were fabricated in Utah to prepare dogbone shaped specimens of the IOL for materials testing. To run the model, material properties from the MCL determined by Krista Ellis, a master’s student at OBI were utilized. I also learned how to measure the in-situ strain in ligaments, but to run the model in Utah, a constant in-situ strain of 3 % was assumed. The model was run in NIKE, a non-linear implicit

code for finite element analysis, and results were plotted using GRIZ, an interactive 3-D post-processing program. All analyses were performed on SGI workstation computers at OBI.

Results showed that the motion causing extension of the IOL was lateral motion of the IOL insertions in a radioulnar direction (away from each other). Predictions of the finite element model displayed trends similar to the experimental model. Levels of stress and stretch were highest in neutral rotation, and lowest in pronation (Figure 1).

In supination, there was a concentration of stretch in the distal fibers of the IOL (near the wrist), the maximum stretch was 1.06, and levels of stretch dropped off rapidly in more proximal fiber groups. In neutral rotation, stretches were higher in more proximal fiber groups, with a maximum of 1.06, and dropped off less in more distal groups compared to supination. In pronation, stretches were overall lower than neutral rotation without much variation across fiber groups. Stresses followed the same trends as stretches. In pronation, the maximum stress predicted was 40 MPa. In neutral rotation and supination, the maximum stress predicted was 55 MPa.

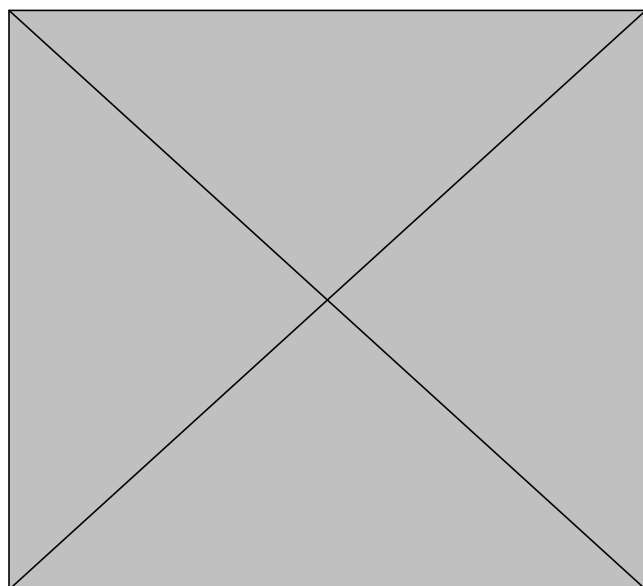


Figure 1. Stretches in the IOL predicted by the model. Arrows indicate radial rotation in pronation/supination.

For this fellowship, a transversely isotropic finite element model of stresses in the IOL under compressive loading of the forearm was successfully developed. New techniques for material testing and measurement of in-situ strain in ligaments were learned. Knowledge of stresses in the IOL is needed to help design ligament reconstructions. It is important to understand which fiber groups are stressed in different forearm rotation positions. These data can be used to help evaluate the ability of a potential ligament reconstruction to replicate the normal forces exerted by the IOL on the bones.

These studies were limited by the use of cadavers and material properties that are not specific to the IOL. Additional work is ongoing to incorporate bidirectional tensile testing of the IOL to provide transverse material properties, measure in-situ strains in the IOL, as well as to design reconstructions of the IOL.

This work would not have been possible without the support of ORLAC. I very much appreciate the opportunity provided to me through ORLAC to travel to OBI and study under the direction of Dr Weiss. This trip was truly a life defining event for me, helping to learn techniques and establish collaboration for a career in orthopaedic biomechanics. Thanks very much to Dr. Weiss and all my new friends at OBI (especially John and Krista) for all the help given to me in Utah. I am forever indebted to ORLAC for providing me with this opportunity, and I highly recommend all graduate students reading this to apply for this fellowship and take advantage of the ORLAC Summer Grant Program.

Marsie A. Janaushek

As the only graduate student in the 'grantless' PCL group, receiving the Erin McGurk summer research grant for 1998 was extremely beneficial. This funding enabled me to continue research on the posterior cruciate ligament throughout the summer months while working in the MSRC, with the assistance of a visiting surgeon from Japan and an orthopaedic resident. The PCL is the largest ligament in the knee and its primary function is to pro-

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Summer Awardees (cont'd)



Marsie and the Robotic/UFS testing system.

vide posterior stability. In some instances, injury to the PCL requires surgical repair to enable return to normal activities. However, no standard procedure exists for PCL reconstruction and long-term results of this procedure are inconsistent and often result in progressive instability and arthritis. During the summer, I sought to elucidate two of the variables of PCL reconstruction in an initial attempt at creating a standardized procedure in the hopes of obtaining more successful and consistent surgical results.

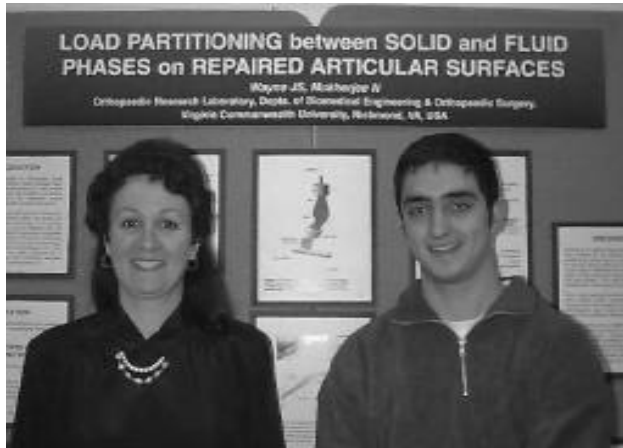
The two variables which I examined were the effect of knee flexion angle and the application of an anterior tibial load at the time of graft fixation. Some clinicians have advocated fixation with the knee in flexion to mimic the high tension in the anterolateral (AL) bundle of the PCL which is taut in flexion, while others have recommended fixing the graft with the knee in extension in order to re-

duce the knee from its subluxed state. Additionally, application of an anterior tibial load to reduce posterior sag prior to graft fixation has also been suggested. With the help of the 2 surgeons, Aki Kanamori and Ben Ma, we examined 5 different reconstructions in each of 10 human cadaveric knees. To examine the effect of flexion angle on the biomechanics of the PCL reconstructed knee, we fixed the graft with the knee at 3 different flexion angles: 1) full extension, 2) 60°, and 3) 90°. The two additional reconstructions were performed at 60° and 90° with the addition of an anterior tibial load. The anterior tibial load was not tested with the knee at full extension as preliminary results showed that this configuration resulted in dangerously high graft forces.

As a result of this study, we determined that the optimal position of the knee at the time of graft fixation for a PCL reconstruction is in flexion with the application of an anterior tibial load. Further, we found that fixing the graft with the knee in full extension resulted in an overconstrained knee, with increased graft forces and the potential for premature graft failure. The results from this study were used as the basis for reconstruction in the follow-up study in which we examined the biomechanics of a double bundle PCL reconstruction. The support from ORLAC for this work was greatly appreciated, it helped to keep the group going as we seek to gain additional funding from other grants.

Michael A. Araj

During the summer of 1998 I was privileged to work with Dr. Jennifer Wayne. It was a great experience. We worked on a project dealing with cartilage. We analyzed the response of articular cartilage under different conditions, which was computer based. Some of the parameters that were chosen were the time the load was set on the cartilage and how much the cartilage was supported by the fluid component of the cartilage. In this experiment fluid pressure relative to position, and stress in the radial and axial positions were measured. A nonlinear permeability model was used throughout the experiment. The objectives of these



Dr. Jennifer Wayne and her student Michael A. Araj, recipient of the Mr. & Mrs. Kwok-Chong Woo Award

tests were to understand how cartilage responds under different conditions.

Cartilage is understood through a biphasic theory, which means that cartilage is composed of two phases. Cartilage has an abundance of collagenous fibers embedded in a rubbery matrix called chondroitin sulfate, a protein-carbohydrate complex which is considered the “liquid phase”. The chondroitin sulfate and collagen are secreted by chondrocytes, which are cells confined to scattered spaces called lacunae in the matrix. The composite of the collagenous fibers and chodroitin sulfate makes cartilage a strong yet somewhat flexible support material which are considered the “solid phase”.

In analyzing the cartilage the variable was the “liquid phase”. We varied the percentage of the load that the liquid phase would support. The values that were used where zero and eighty percent fluid support. In correlation with the percentage load we measured two types of stresses. One is a zz-stress which is a stress measured a stress measured in the axial direction. The rr-stress is the stress measured in the radial direction. There are two directional stresses because the cartilage was in a confined space which causes stress in both directions. Stress was measured in MPa. The stress was greatest at the center surface of the cartilage.

The cartilage was measured 6mm in a radial direction and 1mm in depth. There was a greater stress found when there was zero percent fluid support. This means that the entire load was sup-

ported by solid matrix. There was a greater stress on the cartilage without any fluid support. When the time of the load was increased, the stress on the cartilage also increased in the radial and axial position. Another parameter that was changed was the exponent in the stress equation that was in the program written by Dr. Wayne. The exponents that were used were 1, 5, and 10. All possible combinations of parameters were used, compared, and studied. The data was all graphed with contour plots which made it simple to see how the cartilage was responding to different conditions.

Everything was measured through a program written by Dr. Jennifer Wayne. The program was run through a UNIX system. This project was an extension of a previous project. In doing this experiment, and from working over the summer, I have understood cartilage better than ever. Before entering this program the only thing I knew about cartilage was that it was a flexible bone than supported the joints in your body. A whole new light was brought to me while doing research this past summer. I couldn't see a better way to spend my time, especially intellectually. I had a wonderful experience and learned great amounts of information while doing research at Dr. Wayne's side.



Michael hard at work at the computer.

Fundraising Corner Missing in Action

by Karen Ohland

Greetings to all from the new fundraising chair. I took over the reins from Lars following our most recent fundraising dinner in Anaheim. Many thanks to those who attended; in addition to enjoying wonderful Italian food at Pasta Al Dente, we were able to raise over \$1,000. I hope even more of you will be able to join us in Orlando in the year 2000.

Now for my request; no, not for money, but for volunteers to be members of the Fundraising Committee. Our most pressing task is to improve the accuracy of our current database. If you are interested in assisting with this or any other function of the committee, please let me know (ohlandk@asme.org or 201-460-9502).

Thanks,
Karen

We have lost track of these members of ORLAC. Do you know where they are? Any and all info or suggestions to find info will be greatly appreciated. Please contact Serena by:

phone: (412) 648- 2023
 fax: (412) 648-2001
 email: chanss+@pitt.edu

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|------------------------|------------------------|
| Ron D. Anderson, M.D. | Shi Bai, M.S. |
| Sharon Bansal, B.S. | David Barker |
| Michael I. Danto, Ph.D | Masahiro Inoue, M.D |
| Jim Jamison, M.D. | Amy Kastner, B.S. |
| Ted Kostek, B.S. | Kim Lothringer |
| William Macaulay M.D. | Lisa Maddox, M.D. |
| James Marcin | Michael Marcin, M.D. |
| Chris Powers | Les Schwendeman, M.D. |
| Jason R. Simms, B.S. | Brian Smith, M.D. |
| Jeff Spiegelman, M.S. | William Thompson, M.D. |
| Ick-Hwan Yang, M.D. | |

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