

JOHN C GARDINER, PhD PE
PRINCIPAL, SENIOR BIOMECHANICAL ENGINEER – INJURY BIOMECHANICS GROUP

EDUCATION

Doctor of Philosophy, Bioengineering, University of Utah, 2002.
Bachelor of Science, Mechanical Engineering, University of Minnesota, 1995.

PROFESSIONAL STATUS

Registered Professional Engineer, State of California, January 2005. License M33048.

PROFESSIONAL ASSOCIATIONS

Reviewer, Journal of the Royal Society Interface, since 2009.
Reviewer, Journal of Biomechanics, since 2005.
Society of Automotive Engineers (SAE), since 2003.
Reviewer, Journal of Biomechanical Engineering, since 2003.
American Society of Biomechanics (ASB), since 2002.
Orthopaedic Research Society (ORS), since 2002.
American Society of Mechanical Engineers (ASME), since 1995.

PROFESSIONAL EXPERIENCE

MEA FORENSIC ENGINEERS & SCIENTISTS

Principal, Senior Biomechanical Engineer, 2002 to Present
Conduct accident reconstruction and biomechanical analyses of a variety of events including automobile collisions, slip/trip and fall, and sports injuries. Perform analyses to assess product failure and function in medical device and other fields. Prepare written reports and provide expert testimony.

UNIVERSITY OF UTAH, SALT LAKE CITY, UTAH

Research Associate, 1995 to 2002
Developed and validated finite element (FE) models of the human knee joint which included surface reconstruction from medical image data, FE mesh generation using TrueGrid, nonlinear FE analysis using NIKE3D and model validation with experimental data. Measured structural and material properties of human tissue. Presented work at scientific meetings and published results.

SELF EMPLOYED CONSULTANT

Finite Element Analysis Engineer, 1996 to 2002
Performed FE analyses for design optimization and failure analysis. Analyzed a variety of products, primarily in the medical device industry, including coronary stents, total knee and hip replacements and spinal fusion devices.

UNIVERSITY OF PITTSBURGH, DEPARTMENT OF ORTHOPEDIC SURGERY

Visiting Research Associate, 1999
Measured forces in knee ligaments with a force-moment control robot.

BOSTON SCIENTIFIC SCIMED

Engineering Intern, 1993 to 1995
Designed, built, and tested prototype balloon angioplasty catheters. Implemented quality assurance testing of manufactured catheters.

3M

Technical Aide, 1992 to 1993
Performed quality control testing and analysis of a variety of 3M products including pressure sensitive adhesives, filters, and insulation products.

RESEARCH ACTIVITIES

Measured the impact performance characteristics of various styles of motorcycle helmets using a custom-designed drop tower. Helmets were tested at a range of impact severities and performance was quantified as headform linear acceleration.

Studied the mechanics of the medial collateral ligament (MCL) of the human knee during valgus loading. A combination of experimental and computational methods were utilized that allowed subject-specific finite element models to be created for a series of cadaveric knees. Models were used to predict the stress/strain distribution throughout the MCL as a function of passive flexion and valgus loading. Results were used to indicate specific regions of the MCL that would be most vulnerable to injury under particular loading conditions. This research was funded through the National Institutes of Health and the Whitaker Foundation Biomedical Research and Transition Grants.

Quantified the mechanical response of MCL samples to large deformation simple shear loading under both quasi-static and rate-dependent loading conditions. Developed a nonlinear parameter estimation technique utilizing finite element simulations of individual material tests to estimate material coefficients for a three-dimensional material model. Results indicated that shear stiffness increases with shear strain. This research was funded through the National Institutes of Health and the Whitaker Foundation Biomedical Research and Transition Grants.

Assisted in the development and validation of a finite element model of the inferior glenohumeral ligament of the human shoulder. The model was used to understand the mechanical function of capsular structures of the human shoulder during a clinical exam and to develop experimental and analytical tools to study capsular injury and repair. This project was a collaborative effort involving the University of Pittsburgh and the University of Utah through funding provided by the Whitaker Foundation.

PUBLICATIONS

PEER-REVIEWED JOURNALS

DeMarco AL, Chimich DD, Gardiner JC, Nightingale RW, Siegmund GP (2010). The impact response of motorcycle helmets at different impact severities. *Accident Analysis & Prevention*, 42, pp. 1778-1784.

Siegmund GP, Flynn J, Mang DW, Chimich DD, Gardiner JC (2010). Friction requirements when entering and exiting a dry and wet bathtub. *Gait & Posture*, 31(4), 473-478.

Weiss JA, Gardiner JC, Ellis BJ, Lujan TJ, Phatak NS (2005). Three-dimensional finite element modeling of ligaments: Technical aspects. *Medical Engineering & Physics*, 27, pp 845-861.

Gardiner JC, Weiss JA (2003). Subject-specific finite element models can predict strain in the human medial collateral ligament during valgus knee loading. *Journal of Orthopaedic Research*, 21(6), pp. 1098-1106.

Weiss JA, Gardiner JC, Bonifasi-Lista C (2002). Ligament material behavior is nonlinear, viscoelastic, and rate-independent under shear loading. *Journal of Biomechanics*, 35(7), pp. 943-950.

Gardiner JC, Weiss JA, Rosenberg TD (2001). Strain in the human medial collateral ligament during valgus loading of the knee. *Clinical Orthopaedics and Related Research*, 391, pp. 266-274.

Gardiner JC, Weiss JA (2001). Simple shear testing of parallel-fibered planar soft tissues. *American Society of Mechanical Engineers Journal of Biomechanical Engineering*, 123, pp. 170-175.

Weiss JA, Gardiner JC (2001). Computational modeling of ligament mechanics. *Critical Reviews in Biomedical Engineering* 29(3), pp. 303-371.

PEER-REVIEWED CONFERENCE PROCEEDINGS

Weiss JA, Gardiner JC, Quapp KM (1995). Material models for the study of soft tissue mechanics. In: *Proc. of International Conference of Pelvic and Lower Extremity Injuries*, pp. 249-261, Washington, D.C., December 4-6, 1995.

ABSTRACTS

Bonin SJ, Luck JF, Bass CR, Gardiner JC, Onar-Thomas A, Asfour SS, Siegmund GP (2014). A comparison of cadaver heads and standard headforms in helmet testing. *World Congress of Biomechanics*, Boston, MA, July 6-11, 2014.

DeMarco AL, Gardiner JC, Wilkinson CC, Hassan EA, Siegmund GP (2007). Predicting motorcycle helmet impact severity from residual crush damage. 35th International Workshop on Human Subjects for Biomechanical Research. San Diego, CA, October 28, 2007.

DeMarco AL, Chimich DD, Gardiner JC, Nightingale RW, Siegmund GP (2006). Motorcycle helmet impact response: Comparison of helmet type and impact severity. 34th International Workshop on Human Subjects for Biomechanical Research, Dearborn, MI, November 5, 2006.

Brault JR, Gardiner JC, Chimich DD, Siegmund GP (2004). Biomechanical determinants of injuries from low-level falls. 56th Annual Meeting of the American Academy of Forensic Sciences, Dallas, TX, February 16-21, 2004.

Gardiner JC, Weiss JA (2003). Subject-specific finite element models can predict strain in the human medial collateral ligament under valgus loading. In: Proc. of 49th Annual Meeting of the Orthopaedic Research Society, 28, pg 805, New Orleans, LA, February 2-5, 2003.

Newmann WJ, Debski RE, Gardiner JC, Moore SM, Weiss JA (2002). Function of the anterior band of the inferior glenohumeral ligament during the load and shift test. American Society of Mechanical Engineers International Mechanical Engineering Congress and Exposition, New Orleans, LA, November 17-22, 2002.

Gardiner JC, Weiss JA (2002). Subject-specific finite element modeling of the human MCL. Fourth World Congress of Biomechanics, Calgary, AB, August 4-9, 2002.

Gardiner JC, Rosenberg TD, Weiss JA (2002). In situ strains in the human MCL are non-uniform and transmit significant forces to the bones. In: Proc. of 48th Annual Meeting of the Orthopaedic Research Society, 27, pg 599, Dallas, TX, February 10-13, 2002.

Gardiner JC, Maker BN, Weiss JA (2001). An iterative update algorithm to enforce initial stretch in hyperelastic finite element models of soft tissue. American Society of Mechanical Engineers Summer Bioengineering Conference, 50, pp. 359-360. Snowbird, UT, June 27-July 1, 2001.

Weiss JA, Bonifasi-Lista C, Gardiner JC (2001). Determination of ligament shear properties using a finite element parameter estimation technique. American Society of Mechanical Engineers Summer Bioengineering Conference, 50, pp. 43-44, Snowbird, UT, June 27-July 1, 2001.

Gardiner JC, Weiss JA (2000). Elastic and viscoelastic shear properties of the MCL. In: Proc. of 46th Annual Meeting of the Orthopaedic Research Society, 25, pg. 63, Orlando, FL, March 12-15, 2001.

Gardiner JC, Weiss JA (2000). Strain in the human MCL during valgus loading. In: Proc. of 46th Annual Meeting of the Orthopaedic Research Society, 25, pg. 774, Orlando, FL, March 12-15, 2001.

Pfaeffle J, Weiss J, Gardiner J, Fischer K, Manson T, Tomaino M, Herndon J, Woo SL-Y (2000). The effect of forearm rotation on stress distribution in the interosseous ligament of the human forearm. In: Proc. of 46th Annual Meeting of the Orthopaedic Research Society, 25, pg. 421, Orlando, FL, March 12-15, 2001.

Gardiner JC, Weiss JA (1999). Analysis of transversely isotropic soft tissues under finite shear conditions. American Society of Mechanical Engineers Summer Bioengineering Conference, 42, pp. 443-444. Big Sky, MT, June 16-20, 1999.

Gardiner JC, Weiss JA (1998). Representation of anisotropy in constitutive models of biological soft tissues. American Society of Mechanical Engineers Advances in Bioengineering BED, 39, pp. 263-264, Anaheim, CA, November 15-20, 1998.

Weiss JA, Gardiner JC (1998). Stresses in the human medial collateral ligament during valgus loading. In: Proc. of the 3rd World Congress of Biomechanics, pg. 132, Sapporo, Japan, August 2-8, 1998.

Weiss JA, Gardiner JC (1998). Stresses in the human medial collateral ligament during valgus loading. In: Proc. of the 5th Japan-USA-Singapore-China Conference on Biomechanics, pp. 116-117, Sendai, Japan, August 9-13, 1998.

Gardiner JC, Weiss JA (1998). Experimental testing and computational modeling to determine the stress-strain distribution in the human MCL. In: Proc. of 44th Annual Meeting of the Orthopaedic Research Society, 23(2), pg. 1027, New Orleans, LA, March 16-19, 1998.

Gardiner JC, Weiss JA (1997). Effects of flexion angle and valgus rotation on stresses in the human medial collateral ligament. American Society of Mechanical Engineers Summer Bioengineering Conference, BED 35, pp. 27-28, Sun River, OR, June 11-15, 1997.

Weiss JA, Schauer DA, Gardiner JC (1996). Modeling contact in biological joints using penalty and augmented Lagrangian methods. American Society of Mechanical Engineers Winter Annual Meeting, BED 33, pp. 347-348, Atlanta, GA, November 17-22, 1996.

Weiss JA, Rabbitt RD, Gardiner JC (1996). Tracking the deformation of soft tissue using image-based data and nonlinear continuum mechanics. American Society of Mechanical Engineers Mechanics and Materials Conference, Baltimore, MD, June 12-14, 1996.

OTHER PUBLICATIONS

DeMarco AL, Gardiner JC, Chimich DD (2012). The Biomechanics of Head Injury Causation and Prevention. Claims, Biomechanics and Bodily Injury.

Gardiner JG, Kam CY (2011). Biomechanics of Auto Accidents: Injury mechanics and medical opinion combine to form the testimony for injury causation. The Advocate, August 2011.

LECTURES AND PRESENTATIONS

September 27, 1999 - Structure and function of ligaments and tendons. Guest lecture, Bioengineering 1101 - Introduction to Bioengineering. University of Utah, Salt Lake City, UT.

May 27, 1997 - Finite element modeling of joint mechanics. Guest lecture, Mechanical Engineering 646 - Advanced Finite Element Methods. University of Utah, Salt Lake City, UT.

April 10, 1997 - Computational modeling of the knee joint. Orthopedic Sports Medicine Fellowship Training Seminar. The Orthopedic Specialty Hospital, Salt Lake City, UT.

February 11, 1997 - Mechanical testing of ligaments. Orthopedic Sports Medicine Fellowship Training Seminar. The Orthopedic Specialty Hospital, Salt Lake City, UT.

TRAINING AND PROFESSIONAL DEVELOPMENT

July 6-11, 2014 - 7th World Congress of Biomechanics, Boston, MA.

June 26-29, 2013 - ASME Summer Bioengineering Conference, Sunriver, OR.

August 10-13, 2011 - 35th Annual Meeting of the American Society of Biomechanics, Long Beach, CA.

January 13-16, 2011 - Orthopaedic Research Society Annual Meeting, Long Beach, CA.

January 12, 2011 - 19th Annual Symposium on Computational Methods in Orthopaedic Biomechanics, Long Beach, CA.

November 3-5, 2010 - 54th Stapp Car Crash Conference, Phoenix, AZ.

November 2, 2010 - 38th International Workshop on Human Subjects for Biomechanical Research, Phoenix, AZ.

November 2009 - 53rd Stapp Car Crash Conference, Savannah, Georgia.

November 10, 2008 - Crash Data Retrieval Technician Course, Laguna Hills, CA.

November 3-5, 2008 - 52nd Stapp Car Crash Conference, San Antonio, TX.

January 20-22, 2008 - World Congress on Neck Pain, Los Angeles, CA.

October 29-31, 2007 - 51st Stapp Car Crash Conference, San Diego, CA.

October 28, 2007 - 35th International Workshop on Human Subjects for Biomechanical Research, San Diego, CA.

February 11-14, 2007 - 53rd Annual Meeting of the Orthopaedic Research Society, San Diego, CA.

February 10, 2007 - 15th Annual Symposium on Computational Methods in Orthopaedic Biomechanics, San Diego, CA. Co-moderator of session on spine biomechanics.

November 6-8, 2006 - 50th Stapp Car Crash Conference, Dearborn, MI.

November 5, 2006 - 34th International Workshop on Human Subjects for Biomechanical Research, Dearborn, MI.

September 19-21, 2005 – The Role of Warnings and Instructions, Madison, WI.

February 25-26, 2005 – International Whiplash Trauma Congress, Breckenridge, CO.

November 11-12, 2004 – SAE Seminar – Occupant and Vehicle Kinematics in Rollovers, Troy, MI.

August 20-22, 2004 – CRASH 2004 – Human subjects crash testing and scientific conference, San Diego, CA.

March 22-23, 2004 – SAE Seminar – The role of the seat in rear crash safety, Davis, CA.

October 26, 2003 - 31st Annual International Workshop on Human Subjects for Biomechanical Research, San Diego, CA.

July 28, 2003 - Means of Egress Seminar, Los Angeles Basin Chapter of ICC, Alhambra, CA.

June 29, 2003 - Tribometer Workshop, sponsored by the ASTM Committee F-13 on Pedestrian/Walkway Safety and Footwear, Pasadena, CA.

June 28, 2003 - Biomechanics of Slips and Falls, ASTM F13, Pasadena, CA.

March 28-29, 2003 - Southern California Conference on Biomechanics, Malibu, CA.

November 11-13, 2002 - 46th Stapp Car Crash Conference, Ponte Vedra Beach, FL.

November 10, 2002 - 30th Annual International Workshop on Human Subjects for Biomechanical Research, Ponte Vedra Beach, FL.

September 29, 2002 - Association for the Advancement of Automotive Medicine Biomechanics of Impact Seminar, Tempe, AZ.

August 4-9, 2002 - 4th World Congress of Biomechanics, Calgary, AB.

February 10-13, 2002 - 48th Annual Meeting of the Orthopaedic Research Society, Dallas, TX.

June 27-July 1, 2001 - ASME Summer Bioengineering Conference, Snowbird, UT.

March 12-15, 2000 - 46th Annual Meeting of the Orthopaedic Research Society, Orlando, FL.

March 11, 2000 - 8th Annual Symposium on Computational Methods in Orthopaedic Biomechanics, Lake Buena Vista, FL.

March 11, 2000 - 1st International Symposium on Ligaments and Tendons, Lake Buena Vista, FL.

June 16-20, 1999 - ASME Summer Bioengineering Conference, Big Sky, MT.

February 1-4, 1999 - 45th Annual Meeting of the Orthopaedic Research Society, Anaheim, CA.

January 31, 1999 - 7th Annual Symposium on Computational Methods in Orthopaedic Biomechanics, University of California at Irvine Medical Center, Orange, CA.

March 16-19, 1998 - 44th Annual Meeting of the Orthopaedic Research Society, New Orleans, LA.

March 15, 1998 - 6th Annual Symposium on Computational Methods in Orthopaedic Biomechanics, Tulane University, New Orleans, LA.

June 11-15, 1997 - ASME Summer Bioengineering Conference, Sun River, OR.

February 9-12, 1997 - 42nd Annual Meeting of the Orthopaedic Research Society, San Francisco, CA.

February 8, 1997 - 5th Annual Symposium on Computational Methods in Orthopaedic Biomechanics, University of California at Berkeley, Berkeley, CA.

November 12-17, 1995 - ASME Winter Annual Meeting, San Francisco, CA.

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