



## DAVID L. GUSHUE, Ph.D. PROFESSIONAL BIOGRAPHICAL OUTLINE

### BACKGROUND

Dr. Gushue earned a Ph.D. and an M.S. in Biomedical Engineering at the University of Rochester, Rochester, New York, and a B.S. in Bioengineering with a minor in Neuroscience at Syracuse University, Syracuse, New York. During his Ph.D. dissertation, Dr. Gushue studied the dynamic relationship between mechanical forces and joint disorders, including investigations into growth plate abnormalities, osteoarthritis, and ACL-deficiencies. Using joint contact modeling techniques, Dr. Gushue investigated the distribution of joint contact forces during gait and other activities of daily living, and determined their potential influence on bone growth and soft tissue injuries within joints. In addition to knee joint biomechanics, Dr. Gushue participated in research studies related to biomechanics of the spine and upper extremity. His research included 3-D motion analyses, mathematical modeling, clinical studies involving both adults and children, MR imaging, mechanical testing, and finite element analyses. Dr. Gushue has also completed advanced coursework in the fields of biomechanics, injury tolerance, biomaterials, neuroscience, structural mechanics, impact mechanics, materials engineering, and physiology.

In addition to fulfilling the engineering requirements of his doctorate at the University of Rochester, Dr. Gushue gained valuable experience by providing engineering consultation to a private portfolio company that invested in early-stage innovations related to the fields of biomedical engineering and orthopedics. Dr. Gushue served as an integral part of an interdisciplinary team that formulated initial designs, developed intellectual property and prototypes, and conducted feasibility studies related to improved medical devices for use as total joint replacements.

Dr. Gushue's academic and professional experience represents a unique combination of knowledge in biomechanical engineering, live subject kinematic and kinetic testing, human anatomy and physiology, orthopedics, and medical devices. Currently, he specializes in the study of the kinematics and kinetics of the human body, as well as injury mechanisms, and associated tolerances. Dr. Gushue has served as a consultant for the United States Military, National Institute for Occupational Safety and Health (NIOSH), and various professional sports organizations, including the National Hockey League (NHL).

### SUMMARY OF EXPERIENCE

- Conducted research to determine the influence of mechanical forces on longitudinal bone growth and soft tissue injuries within the lower extremity
- Developed mathematical models to estimate the distribution of joint contact forces within joints during dynamic activities
- Designed and developed unique medical devices for use as joint replacements, including novel approaches for the enhanced integration of the implant with the surrounding tissue
- Assisted with the development of intellectual property providing unique solutions to engineering problems involving the human body
- Conducted clinical research studies involving data collection from both healthy and injured subjects, with a focus on injury-induced kinematic and kinetic alterations
- Currently uses his biomedical engineering skills in the research and analysis of the relationships between crash injuries and crash forces, occupant kinematics and human tolerance, as well as forensic investigations
- Currently provides consultation on various issues related to sports biomechanics, including design and performance of protective equipment and playing surface/facility design



## AREAS OF SPECIALTY

- Biomechanical Consulting
- Human Injury Tolerance
- Orthopedic Implant Design/Medical Devices
- Accident Reconstruction
- Sports Biomechanics
- Human Kinematic Analysis and Testing
- Injury Mechanism Analysis
- Forensic Analysis

## EDUCATION

- Doctor of Philosophy in Biomedical Engineering, University of Rochester, 2005
- Masters of Science in Biomedical Engineering, University of Rochester, 2002
- Bachelors of Science in Bioengineering and Neuroscience, Syracuse University, 1999

## PROFESSIONAL EXPERIENCE

### 2005 – Present | ARCCA, Incorporated | Chief Executive Officer

- Provides sports biomechanics consultation, including design and performance of protective equipment and playing surface/facility design
- Specializes in crash injury analysis, injury mechanism determination, and crash kinematics
- Practices biomechanics to explore the cause, nature, and severity of injuries
- Utilizes medical records, testing, computer modeling, and his extensive knowledge of human injury tolerance to evaluate injury causation given a specific set of actions or exposure to a specific incident environment

### 1999 – 2005 | University of Rochester | Research Assistant

- Conducted research on the dynamic relationship between mechanical forces and joint disorders, including biomechanical investigations related to the lower extremity, spine and shoulder
- Performed three-dimensional motion analyses, mathematical modeling, clinical studies involving both adults and children, MR imaging, mechanical testing, and finite element analyses
- Developed mathematical models to estimate the distribution of joint contact forces within joints during dynamic activities

### 2001 – 2005 | Biomed Solutions, LLC. | Engineering Consultant

- Provided engineering consultation to a portfolio company that invested in inventions and early-stage innovations
- Developed intellectual property related to biomedical engineering and orthopedics
- Conducted extensive prior art research, developed claims, drawings and specifications for the associated inventions

### Summer 1997 – 1999 | Rochester Orthopedics | Prosthetic Technician

- Fabricated custom-fit prostheses for both below- and above-knee amputees in a clinical environment
- Responsibilities included extensive patient interaction, initial evaluation, development and delivery of a prosthetic device

## PROFESSIONAL AFFILIATIONS

- ASTM International
  - F08 Committee on Sports Equipment, Playing Surfaces, and Facilities
- Biomedical Engineering Society
- Association for the Advancement of Automotive Medicine
- Society of Automotive Engineers (SAE)
- Member of the External Advisory Board for the Department of Biomedical Engineering, University of Rochester, Rochester, NY

## MANUSCRIPTS

Whitman, G. R., **Gushue, D.L.**, L. Sicher, (2009). *Crash Protection for Infants Transported in Incubators*. (No. 2009-01-2832). Warrendale, PA, Society of Automotive Engineers.

**Gushue, D.L.**, Joganich T., Probst, B.W., Markushewski, M.L. (2007). *Biomechanics for Risk Managers-Analyses of Slip, Trip & Fall Injuries*. Proceedings of the 2007 ASSE Professional Development Conference. Orlando, FL: ASSE.

Markushewski, M., **Gushue, D.L.**, Probst, B., Coward, C., (2007). *When Driver Safety Fails—Then What? Vehicular Accident Analysis: The Big Picture*. Orlando, FL: ASSE.

**Gushue, D.L.**, B. Probst, et al. (2006). *Effects of Velocity and Occupant Sitting Position on the Kinematics and Kinetics of the Lumbar Spine during Simulated Low-Speed Rear Impacts*. Safety 2006, Seattle, WA, ASSE.

**Gushue, D.L.**, Houck, J., Lerner, A.L. *Increased Tibiofemoral Joint Contact Forces in Children who are Overweight*. [Journal of Orthopaedic Research – In progress].

Lancianese, S.L., **Gushue, D.L.**, Lerner, A.L. *Risks for Trabecular Bone Fatigue in the Proximal Tibia of the Overweight Child*. [Journal of Biomechanics – In progress].

**Gushue, D.L.**, Houck, J., Lerner, A.L. (2005). *Effects of Childhood Obesity on Three-Dimensional Knee Joint Biomechanics During Walking*. *Journal of Pediatric Orthopaedics*, 25(6): 763-768.

**Gushue, D.L.**, Houck, J., Lerner, A.L. (2005). *Rabbit Knee Joint Biomechanics: Motion Analysis and Modeling of Forces During Hopping*. *Journal of Orthopaedic Research*, 23(4): 735-742.

Houck, J., Lerner, A., **Gushue, D.L.**, Yack, J. (2003). *Self-Reported Giving-Way Episode During a Stepping-Down Task: Case Report of a Subject with an ACL-Deficient Knee*. *J Orthop Sports Phys Ther*; 33(5): 273-282. **(Selected for re-publication in the 2004 Year Book of Sports Medicine)**

Chamberlain, S., Weiner, W., Ankrom, L., Carone, T., **Gushue, D.L.**, Kirby, M., Papuga, M., Sacunas, R., Stroope, D. (2000). *Circadian Rhythms in the Limulus Visual System*. In: M. Weckstrom (ed.) *Neuroscience Finland 1999, Acta Universitatis Ouluensis Medica*; D584: 37-42.

## PUBLISHED ABSTRACTS

**Gushue, D.L.**, Lerner, A.L., Houck, J. (2005). *Analysis of Knee Joint Biomechanics and Joint Contact Forces in Overweight Children. Gait and Posture.*

**Gushue, D.L.**, Houck, J., Lerner, A.L. (2005). *Three-Dimensional Knee Joint Biomechanics in Children: Effects of Obesity. Transactions of the Orthopaedic Research Society.*

**Gushue, D.L.**, Lerner, A.L., Houck, J. (2005). *Effects of Childhood Obesity on Three-Dimensional Knee Joint Biomechanics During Walking. Transactions of the American Physical Therapy Association - Combined Sections Meeting.*

Lancianese, S.L., **Gushue, D.L.**, Yao, J, Lerner, A.L. (2005). *Effects of Childhood Obesity on the Distribution of Mechanical Stresses in the Proximal Tibia. Transactions of the 2005 Summer Bioengineering Conference.*

Lerner, A.L., **Gushue, D.L.**, Lancianese, S.L. (2005). *Knee Joint Loads in Children who are Overweight: Risks for Joint Disorders. Transactions of the Biomedical Engineering Society Annual Meeting.*

**Gushue, D.L.**, Long, J., Houck, J., Lerner, A.L. (2003). *Motion Analysis and Mathematical Modeling of the Forces in the Adult Rabbit Knee Joint During Hopping. Transactions of the 2003 Summer Bioengineering Conference.*

**Gushue, D.L.**, Lerner, A.L., Houck, J. (2002). *Analysis of Muscle and Joint Contact Forces in an ACL-Deficient Subject During a Giving-Way Episode Occurring While Stepping Down. Gait and Posture, 16(S1): S93-S94.*

Lerner, A.L., **Gushue, D.L.**, Gedbaw, E.A. (2002). *Mechanical Stress Patterns in the Human Proximal Tibial Growth Plate During the Stance Phase of Normal Gait. ASME-BED, 54: 411-412.*

## PRESENTATIONS

**April 2005**      **Gushue, D.L.**, *Analysis of Knee Joint Biomechanics and Joint Contact Forces in Overweight Children*, 10th Annual Conference for the Gait and Clinical Movement Analysis Society, Portland, OR, April 2005.

**February 2005**      **Gushue, D.L.**, *Three-Dimensional Knee Joint Biomechanics in Children: Effects of Obesity*, 51st Annual Meeting of the Orthopaedic Research Society, Washington, D.C.

**February 2002**      **Gushue, D.L.**, *Variations in Growth Plate Stresses and Fluid Pressures During the Stance Phase of Normal Gait*, (10th Annual Pre-ORS Symposium on Computational Methods in Orthopaedic Biomechanics, Dallas, TX.



## COURSE INSTRUCTION

Lerner, A.M., **Gushue, D.L.**, *Biosolid Mechanics*, University of Rochester, Rochester, NY, Fall 2002.

Lerner, A.M., **Gushue, D.L.**, *Biosolid Mechanics*, University of Rochester, Rochester, NY, Fall 2001.

Waugh, R., **Gushue, D.L.** *Introduction to Biomedical Engineering*, University of Rochester, Rochester, NY, Fall 2000.

## PATENTS

**US 20030130742A1: Apparatus for Replacing Musculo-Skeletal Parts.** Published July 10, 2003 [With Connelly, P.R.]