Torrence D.J. Welch

Ph.D.

Principal and Director of Biomechanics

Dr. Torrence Welch is a Principal and the Director of Biomechanics at ESi. Dr. Welch holds a Ph.D. in Biomedical Engineering awarded jointly by the Georgia Institute of Technology (Georgia Tech) School of Engineering and the Emory University School of Medicine in Atlanta, GA. His areas of expertise include the biomechanics of human injury, vehicle accident reconstruction, slip-and-fall events, occupational injury, reactive muscle activity, and human balance control and stability. Dr. Welch has offered expert testimony in the fields of accident reconstruction and injury biomechanics in Federal, State, and local Courts throughout the United States.

Dr. Welch has nearly 30 years of biomechanics research experience, studying human movement on multiple levels.

- *Injury* – the forces present on the body during automotive collisions and other injurious incidents;
- *Mechanics* – the effects of forces on the bony and soft tissues underlying human movement;
- *Coordination* – the activation of muscles in functional groups called muscle synergies;
- *Control* – the mechanisms used by the nervous system to control standing balance and to learn new balance tasks;
- *Performance* – the effects of supplements on sport and exercise performance

Dr. Welch also has experience in human motion and gait analysis; electromyography (EMG); the computer modeling of biomechanical systems; the mechanical, biochemical, and ultrasound characterization of biological soft tissue; biomedical ultrasound imaging; and statistical and wavelet analysis. Dr. Welch performs biomechanical analyses for litigated matters involving automotive collisions, slip/trip and fall events, falling objects, occupational injury, and other incidents leading to human injury. Dr. Welch is published in numerous publications on topics related to automotive collision-related injury and human standing balance control and actively maintains collaborative research relationships with several academic institutions.

Contact Information

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ESi Atlanta

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Areas of Specialization

- Human Injury Analysis
- Injury Causation/Consistency
- Injury Mechanisms and Tolerance
- Impact Biomechanics
- Occupant Kinematics
- Restraints and Safety Equipment
- Vehicle Driver Identification
- Vehicle-Pedestrian Accidents
- Rollover Biomechanics
- Rail and Maritime Injury
- Occupational Injury/Workers' Compensation
- Product Safety
- Sports and Fitness Equipment
- Slip/Trip and Falls
- Human Balance Control and Recovery
- Surface Electromyography (EMG)
- Anthropomorphic Test Device (ATD) Testing
- Computer Modeling

Education

Ph.D., Biomedical Engineering, Georgia Institute of Technology & Emory University School of Medicine, 2008
M.S.E., Biomedical Engineering, Tulane University, School of Engineering, 2003
B.S.E., Biomedical Engineering, Tulane University, School of Engineering (s*umma cum laude)*, 2003

Licenses & Certifications

ACTAR #2773

Positions Held

Engineering Systems Inc., Peachtree Corners, GA

- Director of Biomechanics, Biomechanics & Safety Practice Group, January 2026 – present
- Principal, Biomechanics & Safety Practice Group, January 2026 – present
- Senior Managing Consultant, Biomechanics & Safety Practice Group, April 2020 – December 2025

Rimkus Consulting Group, Inc., Atlanta, GA

- Principal Consultant, Biomechanics Division, December 2014 – March 2020
- Senior Consultant, Biomechanics Division, January 2013 – December 2014

Exponent, Inc., Phoenix, AZ

- Senior Associate, Biomechanics Practice, January 2010 – December 2012
- Associate, Biomechanics Practice, September 2007 – December 2009

Continuing Education

- **Traffic Accident Reconstruction 1**, Northwestern University Center for Public Safety, 2008
- **Traffic Accident Reconstruction 2**, Northwestern University Center for Public Safety, 2008
- **Business Development for Engineering Consultants**, Harry Keshet, PhD, 2008
- **Marketing for Litigation Consultants**, Harry Keshet, PhD, 2012
- **Using the 3DSSPP Program**, University of Michigan Center for Ergonomics, 2012
- **Traffic Accident Reconstruction 3**, Northwestern University Center for Public Safety, 2013
- **Bosch Crash Data Retrieval Technician**, University of North Florida Institute for Police Technology and Management, 2013
- **HVE Forum**, Engineering Dynamics Company, 2016
- **Injuries, Anatomy, Biomechanics & Federal Regulation**, Society of Automotive Engineers, 2017

- **Advanced Crash Reconstruction Utilizing Human Factors Research**, Northwestern University Center for Public Safety, 2018
- **Energy Methods and Damage Analysis in Traffic Crash Reconstruction**, University of North Florida Institute for Police Technology and Management, 2019
- **Traffic Signal Timing Records Interpretation and Analysis**, University of Tennessee Knoxville Center for Transportation Research, 2020
- **Accident Reconstruction Digital Summit**, Society of Automotive Engineers, 2022
- **Photogrammetry and the Analysis of Digital Media**, Society of Automotive Engineers, 2022
- **Accident Reconstruction Digital Summit**, Society of Automotive Engineers, 2023
- **Injury Biomechanics and Traffic Crash Reconstruction**, Northwestern University Center for Public Safety, 2023
- **Event Data Recorder Update and Analysis**, Ruth Consulting, 2023
- **Accident Reconstruction Digital Summit**, Society of Automotive Engineers, 2024
- **Daubert and Rule 702: Effectively Meeting Challenges to the Admissibility of Opinion Testimony**, John Tate, Esq., 2024
- **Crash Injury Research and Engineering Network (CIREN) Research 2024 Overview**, 2024
- **Event Data Recorder Use in Traffic Crash Reconstruction – Level 1**, University of North Florida Institute for Police Technology and Management, 2025
- **Advanced Driver Assistance Systems for the Crash Reconstructionist**, Northwestern University Center for Public Safety, 2025
- **Hyundai-Kia & Tesla EDR Tools Update**, University of North Florida Institute for Police Technology and Management, 2025
- **Passenger Restraint Safety Systems**, University of North Florida Institute for Police Technology and Management, 2025

Professional Affiliations/Honors

Society of Automotive Engineers

Association for the Advancement of Automotive Medicine

- Member of Policy Committee, 2023 – present

Publications

Welch TDJ, Ting LH. A feedback model predicts muscle activity during human postural responses to support surface translations. *Journal of Neurophysiology* **99**: 1032-1038, 2008.

Welch TDJ, Ting LH. A feedback model explains the differential scaling of human postural responses to perturbation acceleration and velocity. *Journal of Neurophysiology* **101**: 3294–3309, 2009.

Ting LH, van Antwerp KW, Scrivens JE, McKay JL, **Welch TDJ**, Bingham JT, DeWeerth SP. Neuromechanical tuning of nonlinear postural control dynamics. *Chaos* **19**: 026111, 2009.

Welch TDJ, Bridges AW, Gates DH, Heller MF, Stillman D, Raasch CC, Carhart MR. An evaluation of the BioRID II and Hybrid III during low- and moderate-speed rear impact. SAE Technical Paper 2010-01-1031, 2010.

Gates D, Bridges A, **Welch TDJ**, Lam T, Scher I, Yamaguchi G. Lumbar loads in low to moderate speed rear impacts. SAE Technical Paper 2010-01-0141, 2010.

Welch TDJ, Bridges AW, Gates DH, Heller MF, Stillman D, Raasch CC, Carhart MR. An evaluation of the BioRID II and Hybrid III during low- and moderate-speed rear impact. *SAE International Journal of Passenger Cars – Mechanical Systems* **3**: 704–733, 2010.

McKay J, **Welch TDJ**, Vidakovic B, Ting L. Statistically-significant contrasts between EMG waveforms revealed using wavelet-based functional ANOVA. *Journal of Neurophysiology* 109: 591-602, 2012.

Welch, TDJ, Ting LH. Mechanisms of motor adaptation in reactive balance control. *PLoS ONE* 9(5): e96440, 2014.

Fortenbaugh DM, Shibata PA, Meza-Arroyo M, Thobe K, **Welch TDJ**. Flip-Flops: A survey of risk perception and acceptance. *Proceedings of the 66th International Annual Meeting of the Human Factors and Ergonomics Society* **66**(1): 513–517, 2022.

Invited Articles

Imler SM, Bridges AW, **Welch TDJ**. The Science of Slipped Discs. *Georgia Defense Lawyer*, Winter 2012.

Welch TDJ. Beyond Causation: When to Use a Biomechanics Expert. *The Verdict*, Spring 2019.

Welch TDJ. Beyond Causation: When to Use a Biomechanics Expert. *The Prairie Barrister*, Summer 2020.

Fortenbaugh DM, Shibata PA, Meza-Arroyo M, Thobe K, **Welch TDJ**. Flip-Flops: A Survey of Risk Perception and Acceptance. *Georgia Defense Lawyer*, Spring 2023.

Welch TDJ. Beyond Causation: When to Use a Biomechanics Expert. *Georgia Defense Lawyer*, Fall 2025.

In addition to those listed here, Dr. Welch has presented as an invited speaker at conferences for a variety of esteemed industry organizations. Dr. Welch is also an approved instructor offering a suite of courses for CE and CLE credits, covering topics related to injury biomechanics.