

Exponent®
Engineering & Scientific Consulting

Liz Rapp van Roden, Ph.D.

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Professional Profile

Dr. Rapp van Roden evaluates the mechanisms and risks of injury in motor vehicle, construction, occupational and recreational accidents. Her experience ranges from analyses of injury causation in low-energy events to evaluation of injury mechanisms and biomechanical issues related to product design and performance.

Dr. Rapp van Roden has published research on occupational and automotive injuries and has conducted testing to evaluate loads on the body in various scenarios, including cadaveric spine testing and automotive crash and sled tests. She also possesses a background in the biomechanics of the shoulder joint and has extensive experience evaluating upper extremity injuries in children and adults. She currently serves as an Associate Editor for the Journal of Biomechanical Engineering.

Dr. Rapp van Roden's previous research included the evaluation of shoulder biomechanics in children with brachial plexus injuries. Her doctoral research focused on analyzing the effect of instrumented spinal fusion on shoulder motion in children with scoliosis. Dr. Rapp van Roden also has several years of experience in sports biomechanics, specifically in the kinematic analysis of figure skating jumps for the U.S. Figure Skating Association and a partnership with athletic apparel companies to evaluate the biomechanics of breast motion during running.

Prior to joining Exponent, Dr. Rapp van Roden worked as a Research Assistant in the Upper Extremity Biomechanics Lab at the University of Delaware, as well as in the Motion Analysis Lab at Shriners Hospital for Children in Philadelphia, PA and the Gait Lab at Nemours/A.I. DuPont Hospital for Children in Wilmington, DE. She co-authored a Shriners-funded medical research grant examining surgical technique for improving shoulder motion in children with Brachial Plexus Birth Palsy.

Dr. Rapp van Roden is skilled in the use of multiple high-speed motion capture systems, strain gauge force plates, inertial measurement sensors, and electromyography data collection. She has additional experience in the use of biplane fluoroscopy in the analysis of 3D joint kinematics of the shoulder.

Academic Credentials & Professional Honors

Ph.D., Biomechanics and Movement Science, University of Delaware, 2017

M.S., Biomechanics and Movement Science, University of Delaware, 2016

B.S., Mathematics and Economics, Georgetown University, 2008

Phi Beta Kappa Honors Society

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Licenses and Certifications

Certified XL Tribometrist (CXLT)

Professional Affiliations

Society of Automotive Engineers

American Society of Biomechanics

Gait and Clinical Movement Analysis Society

Phi Beta Kappa Honors Society

Publications

Rapp van Roden E, Miller B, Pearson J, Williamson J, Brown T. "Revisiting Rear Seat Safety: Field Evaluations of Relative Injury Risk Across Seating Positions and the Integration of Advanced Rear Seat Belt Systems," SAE Technical Paper 2026-01-0561. DOI: 10.4271/2026-01-0561

Bove R, Elmasry S, Amin D, Aber R, Rapp van Roden E, Miller B. Evaluation of Pedestrian Overturn Risk Associated with Railing Interaction. American Society of Biomechanics Annual Meeting, Pittsburgh, PA, August 13 - 16, 2025.

Rapp van Roden E, Riggin CN, Holyoak DT, Amin D, Hall P, Paredes JJ, Day C, Rodowicz KA, Siskey R, Carhart MR. (2025). Influence of Spinal Bridging Ossification on Mechanical Properties and Fracture Tolerance Under Flexion/Extension Loading. Annals of Biomedical Engineering, 1-10.

Rapp van Roden E, Crosby C, Mortensen J, Rodowicz K. Factors Influencing the Effectiveness of a Center-Mounted Airbag in Reducing Occupant Excursion and Injury Potential in High-Speed Lateral Impacts. SAE Technical Paper 2022-01-0843.

Rapp van Roden E and Zolock J. Using the Instantaneous Center of Rotation to Examine the Influence of Yaw Rate on Occupant Kinematics in Eccentric Planar Collisions. SAE Technical Paper 2022-01-0826.

Toney-Bolger M, Isaacs J, Rapp van Roden E, Croteau J, Dibb A. Seat Belt Latch Plate Design and Pretensioner Deployment Strategies Have Limited Effect on In- and Out-of-Position Occupants in High-Severity Rear-End Collisions. SAE Technical Paper 2022-01-0849.

Rapp van Roden EA, George J, Milan LT, Bove RT. Evaluation of injury patterns and accident modality in step ladder-related injuries. Applied Ergonomics, 96, October 2021, 103492.

Russo SA, Richardson RT, Richards JG, Rapp van Roden EA, Chafetz RS, Topley MT, Zlotolow DA, Kozin SH. Effect of Glenohumeral Reduction Type Combined With Tendon Transfer for Brachial Plexus Injury on Objective, Functional, and Patient-Reported Outcomes. Journal of Hand Surgery (American Volume). 2021 July;46(7):624.e1-624.e11.

Rapp van Roden EA, Peterson DA, Pigman J, Conner BC, Richardson RT, Crenshaw JR. The contribution of counter-rotation movements during fall recovery: A validation study. Journal of Biomechanics, 78, September 2018, pp:102-108.

Rapp van Roden EA, Richardson RT, Russo SA, Rose WC, Nicholson KF, Chafetz RS, Gabos PG, Shah SA, Samdani AF, Richards JG. Analysis of Shoulder Complex Function After Posterior Spinal Fusion in Adolescents with Idiopathic Scoliosis. Journal of Pediatric Orthopaedics, 39(1), January 2019, e32-38.

Rapp van Roden EA, Richardson RT, Russo SA, Rose WC, Chafetz RS, Gabos PG, Shah SA, Samdani AF, Richards JG. Shoulder Complex Mechanics in Adolescent Idiopathic Scoliosis and Their Relation to Patient-perceived Function. Journal of Pediatric Orthopaedics, 38(8), September 2018, e446-e454.

Nicholson KF, Richardson RT, Rapp van Roden EA, Quinton RG, Anzilotti KF, Richards JG. Machine learning algorithms for predicting scapular kinematics. Medical Engineering and Physics, 65, March 2019, pp. 39-45.

Richardson RT, Rapp EA, Quinton RG, Nicholson KN, Knarr BA, Russo SA, Higginson JS, Richards JG. Errors associated with utilizing prescribed scapular kinematics to estimate unconstrained, natural upper extremity motion in musculoskeletal modeling. Journal of Applied Biomechanics, 33(6), Dec 2017, pp: 469-473.

Nicholson KF, Richardson RT, Rapp EA, Quinton RG, Anzilotti KF, Richards JG. Validation of a mathematical approach to estimate dynamic scapular orientation. Journal of Biomechanics, 54, March 2017, pp:101-105.

Rapp EA and Gabos PG. Impact of scoliosis on gait. Handbook of Human Motion. Springer, August 2016, pp: 1-18.

Rapp EA, Richardson RT, Russo SA, Rose WC, Richards JG. A comparison of two non-invasive methods for measuring scapular orientation in functional positions. Journal of Biomechanics, 61, August 2016, pp: 269-274.

Richards RT, Nicholson KF, Rapp EA, Johnston TE, Richards JG. A comparison of methods for estimating scapular kinematics during upper extremity ergometry. Journal of Biomechanics, 49(7), May 2016, pp: 1255-8.

Selected Presentations and Published Abstracts

Rapp van Roden E, Riggin C, Holyoak D, Paredes J, Hall P, Siskey R, Amin D, Carhart M, Rodowicz K Mechanical Properties of Spines with Diffuse Idiopathic Skeletal Hyperostosis vs. Healthy Spines: A Pilot Cadaveric Study. Biomedical Engineering Society Annual Conference, October 2023, Seattle, WA.

Rapp EA, Richardson RT, Conner BC, Petersen DA, Pigman J, Crenshaw JR. Quantifying the contribution of counter-rotation movements during fall recovery: a validation study. American Society of Biomechanics Annual Conference, August 2017, Boulder, CO.

Russo SA, Rapp EA, Kozin SH, Richards JG, Lubahn JD, Zlotolow DA. Shoulder rotation after anterior capsule release versus humeral osteotomy in children with brachial plexus injuries. Annual Meeting of the American Society for Surgery of the Hand, September 2017, San Francisco, CA.

Rapp EA, Richardson RT, Russo SA, Rose WC, Richards JG. A comparison of two non-invasive methods for measuring scapular kinematic in functional positions. Gait and Clinical Movement Analysis Society Conference, May 2017, Salt Lake City, UT.

Rapp EA, Richardson RT, Chafetz RS, Samdani AF, Richards JG. Scapular kinematics in adolescents with idiopathic scoliosis. Gait and Clinical Movement Analysis Society Conference, May 2017, Salt Lake City, UT.

Richardson RT, Rapp EA, Chafetz RS, Russo SA, Zlotolow DA, Kozin SH, Richards JG. Impact of glenohumeral joint congruity on shoulder function in brachial plexus birth palsy. Gait & Clinical Movement Analysis Society Conference, May 2017, Salt Lake City, UT.

Rapp EA, Russo SA, Richardson RT, Rose WC, Richards JG. Evaluation of two non-invasive measures

of scapular orientation in adolescents. Pediatric Orthopaedic Society of North America Symposium, December 2016, Lake Buena Vista, FL.

Rapp EA, Nicholson KF, Richardson RT, Johnston TE, Richards JG. Optimal method for estimating scapular kinematics during upper extremity cycling. American Society of Biomechanics Annual Conference, August 2015, Columbus OH.

Peer Reviews

Journal of Biomechanics

Spine (Phila Pa 1976)

Gait and Posture