

**Carolyn Van Toen (née Greaves), M.A.Sc., P.Eng.
Managing Engineer**

Carolyn Van Toen is a Managing Engineer in Synaptic Analysis Consulting Group's Biomechanical Research Division. Ms Van Toen investigates issues involving mechanisms and tolerances of traumatic human injury. She has expertise in the area of spine and spinal cord injury as well as the mechanical response of biological tissues to loading. Her work includes analysis of occupational, recreational, and transportation injuries as well as those involving consumer products and failure of surgically implantable orthopaedic devices. Her technical skills include finite element analysis, constitutive modeling of soft tissues, motion measurement and analysis, impact testing, fracture detection using acoustic emission measurement, surface electromyography, and multibody human and vehicle modelling (Madymo v 6.2, TNO Automotive).

Ms Van Toen is a PhD Candidate in the Orthopaedic and Injury Biomechanics Group, Department of Mechanical Engineering at the University of British Columbia. She has previously held a position as a Research Associate at Let People Move Clinical Biomechanics Laboratory in Perugia, Italy. She has also held a position as a Mechanical Engineering Associate at MacDonald Dettwiler Robotics where she performed analyses of the space shuttle based Canadarm in collaboration with NASA engineers.

Education and Awards

M.A.Sc., Mechanical Engineering, University of British Columbia, Canada, 2004

B.A.Sc., Mechanical Engineering (First Class Honours), University of Waterloo, Canada, 2001

University of British Columbia Faculty of Applied Science Graduate Award, 2009; University of British Columbia Four Year Fellowship, 2009; Engineers Canada-Manulife Financial Scholarship, 2008; University of British Columbia Bridge Scholarship, 2008-2011 (declined); University of British Columbia University Graduate Fellowship, 2008-2011 (declined); University of British Columbia Pacific Century Graduate Scholarship, 2008-2011 (declined); Natural Sciences and Engineering Research Council of Canada Postgraduate Scholarship, 2008-2011; Claudette-MacKay Lassonde Scholarship, Canadian Engineering Memorial Foundation 2008; Doctoral Entrance Scholarship, Department of Mechanical Engineering University of British Columbia, 2008; International Collaboration on Repair Discoveries (ICORD) Annual Research Meeting Poster Award, 2004 and 2003; Michael Smith Foundation for Health Research Trainee Award, 2002-2004; University of Waterloo Sanford Fleming Co-operative Proficiency Award, 2001; University of Waterloo Dean's Award, 1998.

Memberships

Association of Professional Engineers and Geoscientists of British Columbia (P.Eng.)

Canadian Association of Technical Accident Investigators and Reconstructionists (member)
Society of Automotive Engineers (member)

Selected Publications

Greaves L.L., Van Toen C. Melnyk A., Koenig L., Zhu Q., Tredwell S., Mulpuri K., Cripton P.A. (2009) Pediatric and Adult Three-Dimensional Cervical Spine Kinematics: Effect of Age and Sex Through Overall Motion. *Spine* 34(16):1650-7.

Greaves, C.Y., Gadala, M.S., Oxland, T.R. (2008) A three dimensional finite element model of the cervical spine with spinal cord: an investigation of three mechanisms. *Annals of Biomedical Engineering* 36(3): 396-405

Greaves, L.L., Zhu, Q., Cripton, P.A., Cluff, M., Greaves, C.Y., Melnyk, A., Perdios, A., Tredwell, S., Mulpuri, K. (2007) The Effect of Age and Gender on the Three-Dimensional Kinematics of the Pediatric Cervical Spine. *Proceedings, SAE Digital Human Modeling Conference, SAE No. 2007-01-2495*, selected as one of the top papers in 2007 and published in the *Journal of Passenger Cars*.

Plausinis, D., Greaves, C., Regan, W.D., Oxland, T.R. (2005) Ipsilateral shoulder and elbow replacements: On the risk of periprosthetic fracture. *Clinical Biomechanics*. 20(10):1055-63

Benoit, D., Lamontagne, M., Greaves, C., Liti, A., Cerulli, G. (2005) The Effect of Alpine Ski Boot Cuff Release on Knee Joint Force During the Backward Fall. *Research in Sports Medicine: An International Journal*. 13(4): 317-330.

Greaves, C.Y. (2004) *Spinal Cord Injury Mechanisms: A Finite Element Study*. M.A.Sc. Thesis, University of British Columbia.

Selected Presentations

Van Toen, C., Jones, C.F., Nelson, T.S., Street, J., Cripton, P.A. Simulation of head-first impact using cervical spine specimens, simulated neck muscles, and a Hybrid III ATD head. *Proceedings of the Ohio State University's 5th Annual Injury Biomechanics Symposium*, May 18-19, 2009, Columbus Ohio.

Cripton, P.A., Jones, C.F., Van Toen, C., Itshayek, E. Motion-Preserving Spine Implants Under Traumatic Loading Conditions. *Operational Impact of Cervical Disk Surgery Panel, Aerospace Medical Association*. May 6, 2009, Los Angeles, USA.

Van Toen, C., Gilchrist, S., Morrison, T., Cripton, P.A., Hunter, C. Impact properties of bovine intervertebral discs. *2nd Annual Centre for Hip Health and Mobility Trainee Poster Day*, March 6, 2009, Vancouver BC.



Van Toen, C., Nelson, T.S., Jones, C.F., Street, J., Cripton, P.A. Development of a cadaveric cervical spine model of head-first impact. *2009 International Research Collaboration on Repair Discoveries (ICORD) Annual Research Meeting*, January 19-21, 2009, Vancouver BC.

Van Toen, C. Saari, A., Cripton, P.A. A method for estimating stresses in spine fixators in vivo. *Proceedings of the 2009 International Research Collaboration on Repair Discoveries (ICORD) Annual Research Meeting*, January 19-21, 2008, Vancouver BC.

Greaves, C.Y., Gilchrist, S., Morrison, T., Cripton, P.A., Hunter, C. Impact properties of bovine intervertebral discs. *Proceedings of the 2009 International Research Collaboration on Repair Discoveries (ICORD) Annual Research Meeting*, January 19-21, 2008, Vancouver BC.

Van Toen, C., Sran, M.M., Cripton, P.A., Robinovitch, S.N. Preventing Fall-Related Vertebral Fractures: Effect of Floor Stiffness on Lumbosacral Spine Forces. *Proceedings of the 2008 British Columbia Injury Prevention Conference*, November 19-20, 2008, Vancouver BC.

Van Toen (née Greaves), C.Y., Nelson, T.S., Jones, C.F., Street, J., Cripton, P.A. Development of an in vitro model of head-first impact with a Hybrid III head, surrogate spinal cord and simulated neck muscles. *Proceedings of the 36th NHTSA International Workshop on Human Subjects for Biomechanical Research*, November 2, 2008, San Antonio, Texas.

Nelson, T.S., Van Toen (née Greaves), C.Y., Jones, C.F., Street, J., Cripton, P.A. Experimental Impact to the Hybrid III Head and Cadaveric Cervical Spine with an Advanced Muscle Force Replication System. *Proceedings of the 3rd Annual Workshop on Biomechanical Experiments*, September 16, 2008, Bern, Switzerland.

Greaves, C.Y., Saari, A., Cripton, P.A. A method for estimating stresses in spine fixators in vivo. *Proceedings of the 2008 Northwest Biomechanics Symposium*, May 9-11, 2008, Boise Idaho.

Greaves, C.Y., Gilchrist, S., Morrison, T., Cripton, P.A., Hunter, C. Impact properties of bovine intervertebral discs. *Proceedings of the 2008 Northwest Biomechanics Symposium*, May 9-11, 2008, Boise Idaho.

Ming, K., Abugharbieh, R., Jones, C.F., Greaves, C.Y., Yung, A., Tetzlaff, W., Kozłowski, P., Cripton, P.A. Finite Element Model Validation of Spinal Cord Deformation Analysis Based on MR Imaging Data. *Proceedings of the 2008 Northwest Biomechanics Symposium*, May 9-11, 2008, Boise Idaho.

Greaves, L.L., Cluff, M., Greaves, C.Y., Zhu, Q., Melnyk, A., Perdios, A., Tredwell, S., Mulpuri, K., Cripton, P.A. The Effect of Age and Gender on the Three-Dimensional Kinematics of the Pediatric Cervical Spine. *Proceedings of the 2007 Northwest Biomechanics Symposium*, May 18-19, 2007, Eugene OR.

Greaves, C.Y., Cripton, P.A., Berlemann, U., Dumas, G.A., Nolte, L.P. Failure Load and Strain distribution in the human cervical spine during destructive axial loading. *Proceedings of the 2006 Northwest Biomechanics Symposium*, May 12-13, 2006, Vancouver BC.



Nelson, T., Greaves, C., Reed, S.G., Rankine, R., Crompton, P.A. In Vivo Spinal Cord Material Properties: An Indentation Approach. *Proceedings of the 2005 Northwest Biomechanics Symposium*, May 13-14, 2005, Seattle, WA.

Choo, A., Sparrey, C., Greaves, C., Liu, J., Tetzlaff, W., Dvorak, M., Oxland, T.R. The Effect of Injury Mechanism on Spinal Cord Injury. *Presented at the Materials Research Society Spring Meeting*, March 28-April 1, 2005, San Francisco CA.

Greaves, C., Gadala, M.S., Oxland, T.R. Spinal Cord Injury Mechanisms: A Finite Element Study. *Proceedings of the 34th Neuroscience Meeting*, October 23-27, 2004, San Diego, CA.

Greaves, C., Gadala, M.S., Oxland, T.R. Spinal Cord Injury Mechanisms: A Finite Element Study. *Proceedings of the 22nd National Neurotrauma Symposium*, October 21-22, 2004, San Diego, CA and abstracted in the *Journal of Neurotrauma* 2004 Sept; 21(9): 1307 (P174).

Greaves, C., Gadala, M.S., Oxland, T.R. Spinal Cord Injury Mechanisms: A Finite Element Study. *2nd International Collaboration on Repair Discoveries (ICORD) Research Meeting*, October 18, 2004, Vancouver BC.

Greaves, C., Gadala, M.S., Oxland, T.R. Spinal Cord Injury Mechanisms: A Finite Element Study. *Proceedings of the 5th Combined Meeting of the Orthopaedic Research Societies*, October 10-13, 2004, Banff, AB.

Plausinis, D., Greaves, C., Regan, W. D., Oxland, T. R. Ipsilateral Shoulder and Elbow Replacements: on the Risk of Periprosthetic Fracture. *9th International Congress on Surgery of the Shoulder*, May 2-5, 2004, Washington DC.

Greaves, C., Gadala, M. S., Oxland, T. R. A Finite Element Model of Spinal Cord Contusion. *Proceedings of the 1st International Collaboration on Repair Discoveries (ICORD) Research Meeting*, September 24-25, 2003, Vancouver BC.

Greaves, C., Oxland, T. R., Gadala, M. A Finite Element Model of Spinal Cord Contusion. *21st National Neurotrauma Symposium*, November 6-7, 2003, Biloxi MS and abstracted in the *Journal of Neurotrauma* 2003 Oct; 20(10): 1137 (P433).

Benoit, D. L., Cerulli, G., Lamontagne, M., Caraffa, A., Greaves, C., Liti, A., & Schonuber, H. The effect of rear spoiler release on knee joint kinetics during the backward fall in skiing. *Proceedings of the 5th Symposium on Footwear Biomechanics*, July 5-7, 2001, Zurich, Switzerland.

Benoit, D. L., Cerulli, G., Lamontagne, M., Caraffa, A., Greaves, C., Liti, A., & Schonuber, H. In-Vivo ACL strain behaviour during the backward fall in skiing. *Proceedings of the 18th Congress of the International Society of Biomechanics*, July 8-13, 2001, Zurich, Switzerland.



Benoit, D. L., Cerulli, G., Lamontagne, M., Caraffa, A., Greaves, C., Liti, A., & Schonuber, H. The effect of rear spoiler release on knee joint kinetics during the backward fall in skiing. *Proceedings of the 18th Congress of the International Society of Biomechanics*, July 8-13, 2001, Zurich, Switzerland.

Benoit, D.L., Cerulli, G., Caraffa, A., Liti, A., Brue, S., Greaves, C., Lamontagne, M. (2000). In vivo anterior cruciate ligament strain behaviour during sports specific movements. *Proceedings of the 4th International Conference in Orthopaedics, Biomechanics and Sports Rehabilitation*, December 2000, Assisi, Italy.

Book Chapters

Cripton, P.A. Jones, C.F., Van Toen, C., Itshayek, E. Impact Biomechanics of the Spine. In *Spinal Mechanics for Product Development in the New Millenium*, ed. Ferrara L; Goel V; Yuan H. St. Louis, MO, United States of America: Quality Medical Publishing, Inc. (Forthcoming)

Invited Lectures

Greaves, C. Mathematical Modeling in Injury Biomechanics, University of British Columbia, Department of Mechanical Engineering, Injury Biomechanics Course (ME 436/536), October 2, 2007, Vancouver BC.

Greaves, C. Multibody Modeling in Madymo: Low-Speed Rear Impacts, University of British Columbia, Department of Mechanical Engineering, Injury Biomechanics Course (ME 436/536), November 9, 2006, Vancouver BC.

Greaves, C. Spinal Cord Injury Mechanisms: A Finite Element Study, Neurosurgery Grand Rounds, Department of Neurosurgery, Medical College of Wisconsin, October 15, 2004, Milwaukee WI.

