

CAROLYNE I. ALBERT, Ph.D.  
Mechanical Engineer / Biomechanics and Materials Engineering

Investigates and analyzes biomechanical and biomedical injuries; injury causation; and medical equipment, devices and implants.

**Assesses Injuries:** Applying physics, anatomy and physiology, assesses injuries involving:

- skull fractures
- neck, back and spinal cord injuries
- orthopedic and neurologic injuries
- vascular ruptures
- abdominal organs
- heart, lungs, skin (including burns) and other organs
- musculo-skeletal injuries including joints (i.e., shoulders, knees, ankles and elbows), soft tissues (i.e., rotator cuff, tendons and ligaments), and fracture patterns (torso, long bone, hand, foot or skull)

**Determines Cause:** Applying engineering principles, determines:

- the manner in which tissue failed: the type of loading, the direction of loading and magnitude or size of the load that caused the injury
- if injury patterns are causally related or consistent with the hazardous condition or circumstances claimed
- whether there was sufficient force in the right direction to cause an injury
- the presence of pre-existing conditions and how they affect the injury
- who and/or what action contributed to the injuries
- what could have been done to prevent the injuries

**Typical Personal Injury Cases Involve:**

- motor vehicle collisions
- slips, trips and falls
- medical malpractice or device failures
- occupational and work place injuries
- sports and recreational injuries

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**PROFESSIONAL EXPERIENCE**

- 2017 to present     **Robson Forensic, Inc.**  
*Associate*  
Provide technical investigations, analysis, reports, and testimony toward the resolution of personal injury litigation involving injury analysis and causation, medical equipment, medical devices, and procedures.
- 2009 to present (OREC),     **Marquette University, Milwaukee, WI**  
*Adjunct Research Professor, Orthopaedic & Rehabilitation Engineering Center*
- Department of Biomedical Engineering*     2015-present  
*Shriners Hospitals Postdoctoral Research Fellow, OREC*     2012-2015  
*Advanced Rehabilitation Research Training Fellow, OREC*     2009-2012
- Designed and validated laboratory equipment for mechanical characterization of surgical bone specimens
  - Characterized bone material strength and its relationships to microstructure in children with *osteogenesis imperfecta* OI (brittle bone disease)
  - Conducted kinematic and kinetic analyses of human motion in individuals with orthopaedic conditions
- Adjunct Lecturer, Department of Mechanical Engineering*     2014-2015
- Materials Science (MEEN 2460): Taught an undergraduate course on the structure, processing, mechanics, and failure of metals, polymers, ceramics, and composites
- Adjunct Lecturer, Department of Biomedical Engineering*     2014
- Bone and Soft Tissue Mechanics (BIEN 6931): Developed and taught a graduate course on the structure and mechanics of bones, tendons, ligaments, and cartilage, and the test methods used to characterize their mechanical properties
- 2015 to 2017     **Relius Medical, LLC, Colorado Springs, CO**  
*Biomedical Engineering Consultant*
- Managed the daily operations of a cleanroom, including packaging of medical device product and environmental monitoring
- 1998 to 2009     **The University of British Columbia, Vancouver, BC**  
*Research Assistant, Division of Orthopaedic Engineering Research*     2002-2009
- Developed equipment and methodologies for in vitro mechanical testing of bone grafts simulating physiological loads on hip implants, and measuring implant-bone motion in a cadaveric femur model of revision hip arthroplasty
  - Conducted biomechanical, histomorphometric, and finite element studies that identified the key mechanisms of problematic implant migration into the femur after revision hip arthroplasty with the impaction allografting technique

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*Teaching Assistant, Department of Materials Engineering* 1998-2005

- Biomaterials (MMAT 495): Graded assignments, reports, and exams on biomaterials and their clinical applications (2002-2005)
- Composite Materials (MMAT 494): Prepared and conducted tutorials, and graded assignments and exams on the processing, mechanical behavior, and failure of composite materials (2003-2005)
- Engineering Materials (APSC 278-279): Supervised laboratory work and graded reports and exams on processing, structure, and mechanics of materials (1998-2001, 2002-2005)

*Research Assistant, Composites Group* 1998-2001

- Designed and conducted an experimental study that identified the mechanisms behind angular manufacturing distortions (“spring-in”) encountered when processing fiber-reinforced thermoset composite parts

## EDUCATION

Doctor of Philosophy (Ph.D.), Materials Engineering, The University of British Columbia, Vancouver, BC, 2010

Master of Applied Science (M.A.Sc.), Metals and Materials Engineering, The University of British Columbia, Vancouver, BC, 2001

Bachelor of Engineering (B.Eng.), Mechanical Engineering, Université de Sherbrooke, Sherbrooke, QC, 1996

## PROFESSIONAL MEMBERSHIPS

Orthopaedic Research Society (ORS)

## PUBLICATIONS

*Referred Journal Publications*

**Albert C**, Jameson J, Tarima R, Smith P, Harris G. (2017) “Macroscopic anisotropic bone material properties in children with severe osteogenesis imperfecta.” *Journal of Biomechanics*, 64: 103-111.

Shaker J, **Albert C**, Fritz J, Harris G. (2015) “Recent developments in osteogenesis imperfecta.” *F1000 Research*; 4 (F1000 Faculty Rev): 681.

**Albert C**, Jameson J, Smith P, Harris G. (2014) “Reduced diaphyseal strength associated with high intracortical vascular porosity within long bones of children with osteogenesis imperfecta.” *Bone*; 66: 121-130.

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- Albert C**, Jameson J, Toth J, Smith P, Harris G. (2013) "Bone properties by nanoindentation in mild and severe osteogenesis imperfecta." *Clinical Biomechanics*; 28(1): 110-6.
- Albert C**, Jameson J, Harris G. (2013) "Design and validation of bending test method for characterization of miniature pediatric cortical bone specimens." *Proceedings of the Institution of Mechanical Engineers Part H - Journal of Engineering in Medicine*; 227(2): 105-13.
- Albert C**, Frei H, Duncan C, Fernlund G. (2011) "Mechanisms of stem subsidence in femoral impaction allografting." *Critical Reviews in Biomedical Engineering*; 39(6): 493-510.
- Grover P, **Albert C**, Wang M, Smith P, Harris G. (2011) "Mechanical characterization of fourth generation composite humerus." *Proceedings of the Institution of Mechanical Engineers Part H - Journal of Engineering in Medicine*; 225(12): 1169-76.
- Canseco K, **Albert C**, Long J, Khazzam M, Marks R, Harris G. (2011) "Postoperative foot and ankle kinematics in rheumatoid arthritis." *Journal of Experimental and Clinical Medicine*; 3(5): 233-8.
- Albert C**, Masri B, Duncan C, Oxland T, Fernlund G. (2010) "Influence of cement penetration and graft properties on stem micromotion in impaction allografting – a finite element study." *Clinical Biomechanics*; 25(1): 43-9.
- Park Y, **Albert C**, Yoon YS, Fernlund G, Frei H, Oxland T. (2010) "The effect of abductor muscle and anterior-posterior hip contact load simulation on the in-vitro primary stability of a cementless hip stem." *Journal of Orthopaedic Surgery and Research*; 5(40).
- Albert C**, Masri B, Duncan C, Oxland T, Fernlund G. (2008) "Impaction allografting – the effect of impaction force and alternative compaction methods on the mechanical characteristics of the graft." *Journal of Biomedical Materials Research Part B: Applied Biomaterials*; 87(2): 395-405.
- Park Y, Shin HC, Choi DO, **Albert C**, Yoon YS. (2008) "Primary stability of cementless stem in THA improved with reduced interfacial gaps." *Journal of Biomechanical Engineering*; 130(2): 021008.
- Albert C**, Patil S, Frei H, Masri B, Duncan C, Oxland T, Fernlund G. (2007) "Cement penetration and primary stability of the femoral prosthesis after impaction allografting: a biomechanical study in the cadaveric femur." *Journal of Bone and Joint Surgery British Volume*; 89(7): 962-70.
- Albert C**, Fernlund G. (2002) "Spring-in and warpage of angled thermoset composite laminates." *Composites Science and Technology*; 62(14): 1895-912.
- Cigana P, Favis B, **Albert C**, Vu-Khanh T. (1997) "Morphology-Interface-Property Relationships in Polystyrene/Ethylene-Propylene Rubber Blends. 1. Influence of Triblock Copolymer Interfacial Modifiers." *Macromolecules*; 30(14): 4163-9.

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*Book Chapters*

**Albert C**, Fritz J, Harris G. (2015) “Biomechanics of osteogenesis imperfecta: current concepts and emerging horizons,” in “*Transitional Care in Osteogenesis Imperfecta: Advances in Biology, Technology, and Clinical Practice.*” Editors: Peter Smith MD, Frank Rauch, MD, and Gerald Harris, Ph.D. Shriners Hospitals for Children – Chicago.

**Albert C**, Jameson J, Smith P, Harris G. (2015) “Material and structural aspects of bone in osteogenesis imperfecta” in “*Transitional Care in Osteogenesis Imperfecta: Advances in Biology, Technology, and Clinical Practice.*” Editors: Peter Smith MD, Frank Rauch, MD, and Gerald Harris, Ph.D. Shriners Hospitals for Children – Chicago.

Molthen R, Jameson J, **Albert C**, Smith P, Harris G. (2015) “Role of micro-CT in the visualization, measurement, and quantification of OI bone structure,” in “*Transitional Care in Osteogenesis Imperfecta: Advances in Biology, Technology, and Clinical Practice.*” Editors: Peter Smith MD, Frank Rauch, MD, and Gerald Harris, Ph.D. Shriners Hospitals for Children – Chicago.

*Theses*

**Albert C**. (2009) Mechanical characteristics in impaction allografting – the role of graft density and cement penetration profile, Doctoral Dissertation, The University of British Columbia.

**Albert C**. (2001) Spring-in of angled thermoset composite laminates, Masters Thesis, The University of British Columbia.

*Papers Presented at Scientific Meetings*

Jameson J, **Albert C**, Busse B, Smith P, Harris G. (2013) “3D micron-scale imaging of the cortical bone canal network in human osteogenesis imperfecta (OI).” *Proceedings of the SPIE Medical Imaging Conference*, Editors: John Weaver, Robert Molthen. February 9-14, Lake Buena Vista, FL.

Jameson J, **Albert C**, Smith P, Molthen R, Harris G. (2011) “Micro-CT characterization of human trabecular bone in osteogenesis imperfecta.” *Proceedings of the SPIE Medical Imaging Conference*, Editors: John Weaver, Robert Molthen. February 12-17, Lake Buena Vista, FL.

Fernlund G, Poursartip A, Twigg G, **Albert C**. (2003) “Residual stress, spring-in and warpage in autoclaved composite parts.” *Proceedings of the 14<sup>th</sup> International Conference on Composite Materials*, July 14-18, San Diego, CA.

**Albert C**, Poursartip A, Fernlund G. (2001) “The effect of part design and process parameters on spring-in of angled composite parts.” *Design, Manufacturing & Application of Composites: Proceedings of the 3<sup>rd</sup> Canadian International Conference on Composites*, August 21-24, Montreal, QC.

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*Refereed Conference Abstracts and Presentations*

Radmanovic K, Fritz J, Albert C, Moore J, Gilat-Schmidt T, Tarima S, Smith P, Harris. (2021) "Mechanical property changes of pediatric cortical bone due to saline storage time." Virtual 45th Meeting of the American Society of Biomechanics, August 10-13.

Rossmann A, Radmanovic K, Harris G, **Albert C**, Smith P, Fritz J. (2020) Evaluation of texture features from micro-computed tomography of osteogenesis imperfecta bone specimens. Virtual 44th Meeting of the American Society of Biomechanics, August 4-7.

Radmanovic K, **Albert C**, Fritz J, Smith P, Harris G. (2019) "Characterization of Bone Material Properties in Pediatric Cases of Severe Osteogenesis Imperfecta." International Society of Biomechanics/American Society of Biomechanics ISB/ASB 2019, July 31-August 4, 2019, Calgary, AB, Canada.

Fritz J, Garman C, **Albert C**, Bauwens J, Hackbarth D, King D, Neilson J, Harris G. (2017) "Lower body kinematics and joint reaction forces with distal femoral endoprostheses following limb salvage surgery for treatment of osteosarcomas." *38<sup>th</sup> Annual Meeting of the American Society of Biomechanics*, August 8-11, Boulder, CO.

Fritz J, Grover G, Grosland N, **Albert C**, McGrady L, Wang M, Harris G. (2015) "Validation of a finite element model of the humerus for fracture risk assessment during assisted ambulation." *36<sup>th</sup> Annual Meeting of the American Society of Biomechanics*, August 5-8, Columbus, OH.

Fritz J, **Albert C**, Grosland N, Smith P, Harris G. (2015) "Finite element assessment of pediatric femoral response to loading during ambulation: normal vs. osteogenesis imperfecta (OI) bone." *36<sup>th</sup> Annual Meeting of the American Society of Biomechanics*, August 5-8, Columbus, OH.

**Albert C**, Jameson J, Smith P, Harris G. (2015) "Reduced cortical bone strength in children with brittle bone disease associated with increased vascular porosity." *National Advanced Rehabilitation Research Training Conference*, April 31-May 1, Alexandria, VA.

**Albert C**, Smith P, Harris G. (2014) "Compromised bone tissue strength in children with OI type III." *12<sup>th</sup> International Conference on Osteogenesis Imperfecta*, October 12-15 Wilmington, DE.

**Albert C**, Jameson J, Harris G, Smith P. (2014) "Bone material properties in osteogenesis imperfecta: a matter of quantity over quality." *Annual Meeting of the American Society for Bone and Mineral Research*, September 12-15, Houston, TX.

**Albert C**, Jameson J, Smith P, Harris G. (2014) "Reduced bone strength associated with elevated cortical porosity in osteogenesis imperfecta." *World Congress of Biomechanics*, July 6-11, Boston, MA.

Fritz J, Rankine L, Hackbarth D, King D, Neilson J, **Albert C**, Tarima S, Harris G. (2014) "Gait and strength analyses in persons with distal femoral tumor endoprostheses." *World Congress of Biomechanics*, July 6-11, Boston, MA.

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**Albert C**, Jameson J, Smith P, Harris G. (2014) "Understanding bone fragility in brittle bone disease." *Annual Meeting of the Orthopaedic Research Society*, March 15-18, New Orleans, LA.

Jameson J, Proctor A, **Albert C**, Harris G. (2013) "3D visualization of reference-point indentation in human and murine bones." *Annual Meeting of the American Society for Bone and Mineral Research*, October 4-7, Baltimore, MD.

**Albert C**, Smith P, Harris G. (2013) "Decreased bone material strength in severe osteogenesis imperfecta (OI)." *37<sup>th</sup> Annual Meeting of the American Society of Biomechanics*, September 4-7, Omaha, Nebraska.

**Albert C**, Jameson J, Smith P, Harris G. (2013) "Material properties of brittle bones." *24<sup>th</sup> Congress of the International Society for Biomechanics*, August 4-9, Natal, Brazil.

**Albert C**, Jameson J, Toth J, Smith P, Harris G. (2012) "Storage and loss moduli of bone in osteogenesis imperfecta (OI)." *36<sup>th</sup> Annual Meeting of the American Society of Biomechanics*, August 15-18, Gainesville, FL.

**Albert C**, Jameson J, Toth J, Smith P, Harris G. (2012) "Intrinsic modulus of bone in osteogenesis imperfecta – a nanoindentation study." *17<sup>th</sup> Biennial Meeting of the Canadian Society for Biomechanics*, August 15-18, Burnaby, BC, Canada.

Jameson J, **Albert C**, Molthen R, Smith P, Harris G. (2011) "A multi-disciplinary approach for biomechanical testing of bone in osteogenesis imperfecta." *11<sup>th</sup> International Conference on Osteogenesis Imperfecta, EURORDIS Rare Diseases Europe*, October 2-5, 2011, Dubrovnik, Croatia.

**Albert C**, Jameson J, Smith P, Harris G. (2011) "Validation of a 3-pt bending technique for small bone specimens." *35<sup>th</sup> Annual Meeting of the American Society of Biomechanics*, August 2-4, Long Beach, CA.

Jameson J, **Albert C**, Smith P, Harris G. (2011) "Validation of an electromechanical three-point bending system for the determination of oim/oim bone mechanical properties." *57<sup>th</sup> Annual Meeting of the Orthopaedic Research Society*, January 13-16, Long Beach, CA.

**Albert C**, Patil S, Frei H, Masri B, Duncan C, Oxland T, Fernlund G. (2007) "Cement penetration and primary stability of the femoral prosthesis after impaction allografting." *Institution of Mechanical Engineers, Engineers & Surgeons: Joined at the Hip*, April 19-21, London, England.

**Albert C**, Masri B, Duncan C, Fernlund G, Oxland T, Fernlund G. (2007) "Impaction allografting – The effect of impaction force and alternative compaction methods on the mechanical properties of the graft bed." *Institution of Mechanical Engineers, Engineers & Surgeons: Joined at the Hip*, April 19-21, London, England.

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**Albert C**, Patil S, Frei H, Masri B, Duncan C, Oxland T, Fernlund G. (2007) "Impaction allografting – The importance of the cement-bone interface on implant primary stability. *Annual Meeting of the Orthopaedic Research Society*, February 11-14, San Diego, CA.

**Albert C**, Masri B, Duncan C, Oxland T, Fernlund G. "(2007) Impaction allografting – The effect of impaction force and alternative compaction techniques on the graft bed mechanical properties." *Annual Meeting of the Orthopaedic Research Society*, February 11-14, San Diego, CA.

**Albert C**, Patil S, Frei H, Masri B, Duncan C, Oxland T, Fernlund G. (2006) "Effect of cement pressurization on stem in-vitro stability with impaction allografting." *5<sup>th</sup> World Congress of Biomechanics*, July 29-August 4, Munich, Germany.

**Albert C**, Park Y, Frei H, Fernlund G, Yoon YS, Oxland T. (2006) "Effect of abductor and posterior hip contact load on in-vitro cementless stem motion." *40<sup>th</sup> Annual Meeting of the Canadian Orthopaedic Research Society*, June 2-4, Toronto, ON, Canada.

**Albert C**, Patil S, Frei H, Masri B, Duncan C, Oxland T, Fernlund G. (2006) "Effect of cement pressurization on stem primary stability in revision hip replacement with impaction allografting." *25<sup>th</sup> Annual Meeting of the Canadian Biomaterials Society*, May 26-28, Calgary, AB, Canada.

**Albert C**, Park Y, Frei H, Fernlund G, Yoon Y, Oxland T. (2006) "In-vitro testing of the primary stability of a cementless stems: the effect of abductor simulation and the posterior hip contact force." *Northwest Biomechanics Symposium*, May 12-13, Vancouver, BC, Canada.

**Albert C**, Park Y, Frei H, Fernlund G, Yoon Y, Oxland T. (2006) "Effect of abductor and anterior-posterior hip joint load on in-vitro cementless stem motion." *52<sup>nd</sup> Annual Meeting of the Orthopaedic Research Society*, March 19-22, Chicago, IL.

#### *Invited Lectures*

"Material basis for bone fragility in osteogenesis imperfecta," Medical College of Wisconsin, 18<sup>th</sup> Annual John S. Gould Lectureship/Scientific Day, Wauwatosa, WI, June 19, 2015.

"Bone characterization for improved care of children with osteogenesis imperfecta," Shriners Hospitals for Children, 23<sup>rd</sup> Annual Sofield Lectures, Chicago, IL, November 2, 2012.

"Materials science approaches to bone characterization in osteogenesis imperfecta," Shriners Hospitals for Children, Millar Research Lectures, Chicago, IL, May 11, 2012.

"Approaches for characterizing material strength and toughness of bone in osteogenesis imperfecta," Shriners Hospitals for Children, OI meeting: Transitional Care in OI – Advances in Biology, Technology and Clinical Practice, Chicago, IL, September 10, 2010.

"Mechanical characteristics in impaction allografting – the roles of graft density and cement penetration profile," The University of British Columbia, Bagby Research Symposium, Vancouver, BC, Canada, May 19, 2010.



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**FELLOWSHIPS AND AWARDS**

- 2012 to 2015 Shriners Hospitals Postdoctoral Research Fellowship
- 2013 Clinical Biomechanics Award – Finalist, International Society of Biomechanics
- 2012 Student Poster Competition Award – 2<sup>nd</sup> Place, Great Lakes Biomedical Conference
- 2009 to 2012 Advanced Rehabilitation Research Training Postdoctoral Fellowship in Pediatric Mobility National Institute on Disability and Rehabilitation Research
- 2004 to 2006 Senior Graduate Studentship, Michael Smith Foundation for Health Research
- 2006 George Bagby Award for Orthopaedic Engineering Research, The University of British Columbia
- 2006 Best Graduation Presentation, Materials Engineering Research Colloquium, The University of British Columbia
- 2002 to 2003 Cy and Emerald Keyes Scholarship in Materials Engineering, The University of British Columbia

**SERVICE TO PROFESSIONAL ORGANIZATIONS**

- 2014 to Present Journal of the Mechanical Behavior of Biomedical Materials, Reviewer
- 2008 to Present Clinical Biomechanics, Reviewer
- 2012 to 2014 Proceedings of the Institution of Mechanical Engineers, Part H: Journal of Engineering in Medicine, Reviewer
- 2014 International Journal of Nanomedicine, Reviewer
- 2014 Journal of Musculoskeletal and Neuronal Interactions, Reviewer
- 2013 Medical Engineering and Physics, Reviewer
- 2013 ASME Journal of Medical Devices, Reviewer