

THE EXPERTS Robson Forensic

VALENTINA NGAI, PH.D., P.ENG.
Biomedical Engineer / Biomechanics and Bioengineering

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:

- Traumatic brain injuries and skull fractures
- Maxillofacial trauma
- 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 device failures.
- Occupational and work place injuries.
- Sports and recreational injuries.

PROFESSIONAL EXPERIENCE

2010 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.

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- 2020 **Loyola University Chicago**
Part-time Instructor – Department of Engineering Science Jan-May 2020
Taught Materials Engineering to undergraduates majoring in biomedical engineering, electrical engineering and environmental engineering, complying with ABET (Accreditation Board for Engineering & Technology) accreditation.
- 2005 to 2010 **Rush University Medical Center, Chicago, IL**
Research Assistant/Scientist: Department of Orthopedic Surgery – Tribology and Human Motions Laboratories
- Developed a polymer-staining technique for orthopaedic polymers to track wear *in vitro*.
 - Conducted material evaluation through wear simulator studies for joint implants including spine.
 - Identified specific *in vivo* loading and motion profiles at the knee during walking and the relationship with wear by working with TKR patients and *in vitro* knee simulation.
 - Tested and evaluated the biomechanical and tribological efficacy of different TKR implant designs
 - Analyzed the kinematics and kinetics of human motion for various activities.
 - Executed biomechanical computation using inverse dynamics and gait data.
- 2007 **University of Illinois at Chicago, Chicago, IL** Jan.-Apr. 2007
Teaching Assistant: Department of Bioengineering
- Prepared lectures and student projects.
 - Supervised laboratory work for a senior/graduate level bioengineering course (Orthopaedic Biomaterials).
- 2003 to 2005 **University of Waterloo, Waterloo, ON** Jan.-Aug. 2005
Research Assistant/Scientist: Department of Physics and Astronomy
- Quantified protein adhesion onto polymer surfaces using quartz crystal microbalance (QCM).
 - Analyzed protein deposits and examined contact lens surfaces using various imaging methods.
 - Investigated the thermal stability of proteins using spectroscopy and surface plasmon resonance.
- Research Assistant/Scientist: Department of Mechanical Engineering* May 2002-Dec. 2004
- Developed a simulator apparatus to study friction of the anterior surface of contact lenses.
 - Investigated the frictional effects of material-type, protein deposition and normal load on the lens surface.
 - Utilized different imaging methods to investigate the surfaces of contact lenses.
 - Developed a theoretical lubrication model of the experimental configuration.
- Teaching Assistant: Dept. of Mechanical Engineering* May-Dec. 2003 and
May-Sept. 2004
- Prepared and conducted tutorials.
 - Administered and graded projects and examinations (3rd year mechanical engineering course – Kinematics and Dynamics of Machines) with class sizes of approximately 70 to 80 students.

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- 1999 to 2002 **The Greer Galloway Group Inc.**, Belleville, ON
Assistant Project Manager
- Performed preliminary and detailed highway designing, transportation planning, traffic analyses.
 - Analyzed stormwater and sewer systems and management.
 - Conducted environmental studies.
 - Was responsible for quality control, cost estimating, project budgeting and technical report preparation.
 - Presented highway designs in public meetings and liaised with clients and sub-consultants.
- 1998 to 1999 **Stantec Consulting Ltd.**, Winnipeg, MB
Environmental Technologist
- Conducted Phase I, II and III environmental sight assessments (ESA).
 - Performed background research, project planning and scheduling.
 - Supervised sub-surface geotechnical investigations and analyses, excavations and utility coordination.
 - Conducted soil and water sampling, environmental risk assessments, effluent/ leachate management.
 - Prepared technical reports and liaised with clients and sub-consultants.
- 1994 to 1996 **Analytical Services Unit (Queen's University)**, Kingston, ON
Laboratory Assistant June-Aug. 1994-1996
- Prepared soil, water and filtered air samples for contamination analysis (contaminants such as hydrocarbons, phenol, fluoride and various ions) using chromatography and atomic absorption.

PROFESSIONAL CREDENTIALS

Professional Engineer: Ontario (PEO) – Licensed Professional Engineer
CrossFit Level 1 Trainer's Certification
CrossFit Level 2 Trainer's Certification
CrossFit Endurance Certification
CrossFit Movement and Mobility Certification
CrossFit Powerlifting Certification
CrossFit Defense
USA Weightlifting Level 1 Weightlifting Coach Certification
British Association Teachers of Dance (BATD) Certifications in Ballet and Jazz
YMCA Certifications in Strength Training and Aerobics Instruction

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EDUCATION

Doctor of Philosophy (Ph.D.), Bioengineering, University of Illinois at Chicago (UIC), Chicago, IL, 2010
Master of Applied Science (MAsc.), Mechanical Engineering, University of Waterloo, Waterloo, ON, 2005
Bachelor of Applied Science (BAsc.), Civil Engineering, University of Manitoba, Winnipeg, MB, 1999

PROFESSIONAL MEMBERSHIPS

Professional Engineers of Ontario (PEO)
Orthopaedic Research Society (ORS)
American Society for Testing and Materials (ASTM)
ASTM Committee F04 (Medical and Surgical Materials and Devices)
American Society of Biomechanics

PUBLICATIONS

Books:

Medley JB and **Ngai V.** "Biotribology of Contact Lenses" in "Encyclopedia of Tribology." Editors: Q. Jane Wang and Yip-Wah Chung. Biotri Springer Science+Business Media: New York, 2013.

Refereed Journal Publications:

Ngai V, Kunze J, Cip Johannes, Laurent M, Jacobs J and Wimmer MA. (2020) "Backside Wear of Tibial Polyethylene Components is Affected by Gait Pattern: A Knee Simulator Study using Rare Earth Tracer Technology." Journal of Orthopaedic Research 10.1002/jor.24720, p.1-10. <https://doi.org/10.1002/jor.24720>

Ngai V and Wimmer MA. (2015) "Variability of TKR Knee Kinematics and Relationship with Gait Kinetics: Implications for Total Knee Wear." BioMed Research International. 2015 (284513), p.1-6. <http://dx.doi.org/10.1155/2015/284513>

Kunze J, **Ngai V,** Koelling S, Jacobs JJ and Wimmer MA. (2013) "The use of Europiumstearate to trace polyethylene wear debris in joint fluid after prosthetic joint replacement - A feasibility study." Trends in Applied Spectroscopy, 10, p.43-48.

Lundberg H, **Ngai V** and Wimmer M. (2012) "Comparison of ISO Standard and TKR patient axial force profiles during the stance phase of gait." Proc. Instn Mech Engrs, Part H: J.Engineering Medicine, 226(3), p.229-236.

Ngai V and Wimmer M. (2009) "Kinematic evaluation of cruciate-retaining total knee replacement patients during level walking: A comparison with the displacement-controlled ISO standard." J, Biomechanics, 42(14), p.2363-2368.

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Ngai V, Schwenke T and Wimmer M. (2009) "In vivo kinematics of knee prostheses patients during level walking compared with the ISO-1 force-controlled simulator standard." Proc. Instn Mech Engrs, Part H: J.Engineering Medicine, 223(H7), p.889-896.

Ngai V, Wimmer M and Kuntz J. (2009) "Rare earth stearates for wear determination of UHMWPE bearings." Wear, 267, p. 679-682.

Teichroeb JH, Forrest JA, **Ngai V**, Marin JW, Jones L and Medley J. (2008) "Imaging protein deposits on contact lens materials." Optom Vis Sci, 85(12), p.1151-64.

Teichroeb JH, Forrest JA, **Ngai V** and Jones LW. (2006) "Anomalous thermal denaturing of proteins adsorbed to nanoparticles." European Physical Journal E – Soft Matter, 21(1), p.19-24.

Ngai V, Medley JB, Jones L, Forrest J and Teichroeb J. (2005) "Friction of Contact Lenses: Silicone Hydrogel versus Conventional Hydrogel." Tribology and Interface Engineering Series No.48: Ed.: B.J Briscoe, Elsevier B.V., 371-379. [Written discussion, pg. 872-74]. **Presented** at the 31st Leeds-Lyon Symposium on Tribology – Life Cycle Tribology, Leeds, UK, Sept 7-10, 2004.

Invited Talks:

Wimmer MA., **Ngai V.**, Kunze J., Cip J., Laurent M and Jacobs J. (2019) "Backside Wear of Tibial Polyethylene Components is affected by Gait Pattern: A Knee Simulator Study using Rare Earth Tracer Technology." ISTA 32nd Annual Congress, October 2-5, Toronto, Canada.

Ngai V and Wimmer MA. (2008) "Functional Knee Kinematics in Comparison with the ISO Standards." 10th International Essen Symposium, March 12-14, Essen, Germany.

Refereed Published Abstracts and Conference Presentations:

Ngai V, Truman M, Williams J and Medley J. (2018) „Forensic Application of Biotribology.“ 4th International Conference on BioTribology, Sept 26-29, Montreal, QC, Canada.

Cip J, Pourzal R, **Ngai V**, Wimmer MA and Laurent M. (2014) "Influence of Gait on Polyethylene Wear Particle Size and Morphology – A Knee Simulator Study." 60th Annual Meeting of Orthopaedic Research Society, Mar 15-18, New Orleans, LA, USA.

Ngai V, Uth T, Kunze J and Wimmer MA. (2011) "Backside Wear of Tibial Polyethylene Components is Affected by Gait." 57th Annual Meeting of Orthopaedic Research Society, Jan 13-16, Long Beach, CA, USA.

Orozco DA, **Ngai V** and Wimmer MA. (2011) "Development of a Multi-Activity Protocol for TKR Wear Assessment." 57th Annual Meeting of Orthopaedic Research Society, Jan 13-16, Long Beach, CA, USA.

Wimmer MA, Templeton J, **Ngai V**, Mundermann A and Jacobs JJ. (2011) "Post-operative Knee Flexion Moment drives TKR Kinematics during Walking and is related to Tibial Component Position." 57th Annual Meeting of Orthopaedic Research Society, Jan 13-16, Long Beach, CA, USA.

Lundberg H, **Ngai V** and Wimmer MA. (2010) "Comparison of TKR Patient and ISO Standard Axial Force Profiles during Stance." 56th Annual Meeting of Orthopaedic Research Society, Mar. 6-9, New Orleans, LA, USA.

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Wimmer MA, Kunze J, **Ngai V**, Gallardo L, Laurent MP and Jacobs JJ. (2009) "Lanthanides to Trace Wear Debris of Polymers In Vivo." *11th Essen Symposium on Biomaterials and Biomechanics: Fundamentals and Clinical Applications*, March 5-7, Essen, Germany.

Wimmer MA, Orozco DA, **Ngai V**, Lundberg HJ, Foucher KC, Laurent MP and Jacobs JJ. (2009) "In Search of the Appropriate Testing Conditions and Input Profile for Knee Wear Simulation." *2nd Workshop on Biotribology – Bridging Engineering and Medicine & COST 533 Action on Materials for Improved Wear Resistance of Total Artificial Joints*, May 25-27, Guimarães, Portugal.

Ngai V and Wimmer MA. (2009) "Are TKR Knee Kinematics Influenced by Gait Kinetics." *55th Annual Meeting of the Orthopaedic Research Society*, Feb. 22-25, Las Vegas, Nevada, USA.

Lundberg H, Foucher K, **Ngai V**, Rojas I, Swanson A and Wimmer MA (2009) "The Influence of Kinematic Input Variability on Calculated Knee Joint Contact Forces." *55th Annual Meeting of the Orthopaedic Research Society*, Feb. 22-25, Las Vegas, Nevada, USA.

Ngai V, Kunze J and Wimmer MA. (2008) "Validating Rare Earth Stearates for Wear Determination of UHMWPE Bearings." *17th International Conference on Wear of Materials*, Apr.19-23, 2009.

Wimmer MA, **Ngai V**, Orozco D, Jacobs JJ, Laurent MP and Kunze J. (2008) "Rare Earth Tracers to Determine Polyethylene Wear in Total Knee Prostheses." *17th International Conference on Wear of Materials*, Apr.19-23, 2009.

Wimmer MA, **Ngai V**, Swanson A, Paul P, Laurent MP and Jacobs JJ. (2008) "A Comparison Between In Vivo Contact Pathway and Wear Scars of Postmortem Retrieved Components." *16th Congress European Society of Biomechanics*, July 6-9, Lucerne, Switzerland.

Ngai V, Schwenke T and Wimmer MA. (2008) "Knee Kinematics Following Total Joint Arthroplasty versus ISO Standard Profiles." *54th Annual Meeting of the Orthopaedic Research Society*, March 2-5, San Francisco, California, USA.

Orozco DA, Briggs AL, **Ngai V** and Wimmer MA. (2008) "Occurrence of Daily Activity Transitions in an Active TKR Population." *54th Annual Meeting of the Orthopaedic Research Society*, March 2-5, San Francisco, California, USA.

Lundberg HJ, **Ngai V**, Swanson A and Wimmer MA. (2008) "Contribution of Hip and Knee Flexion Angles to the Quadriceps Extension Moment during Stance of Level Walking." *54th Annual Meeting of the Orthopaedic Research Society*, March 2-5, San Francisco, California, USA.

Wimmer MA, Kunze J, Orozco D, **Ngai V**, Laurent MP and Jacobs JJ. (2008) "Rare Earth Tracers to Determine Backside Wear of TKA Polyethylene Inserts." *54th Annual Meeting of the Orthopaedic Research Society*, March 2-5, San Francisco, California, USA.

Ngai V and Wimmer MA. (2007) "Variability in secondary motions of the knee following total joint replacement." *2007 Annual Conference of the American Society of Biomechanics*, August 22-25, Palo Alto, California, USA.

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Lundberg H, Swanson A, **Ngai V** and Wimmer MA. (2007) "Effect of the knee joint contact path on the quadriceps extension moment during gait." *2007 Annual Conference of the American Society of Biomechanics*, August 22-25, Palo Alto, California, USA.

Swanson AJ, **Ngai V**, Inoue N and Wimmer MA. (2007) "Analysis of the tibio-femoral contact point in total knee replacement using a marker based motion analysis system." *ASME 2007 Summer Bioengineering Conference*, June 20-24, Keystone, Colorado, USA.

Ngai V, Kunze J and Wimmer MA. (2007) "A rare earth tracer for accurate wear determination of polyethylene." *16th International Conference on Wear of Materials*, April 15-19, Montreal QC, Canada.

Wimmer MA, **Ngai V** and Kunze J. (2006) "Europium as a candidate staining material to determine polyethylene wear." *Proceedings of ASME IMECE 2006. ASME International Mechanical Engineering Congress & Exposition*: November 5-10, Chicago, Illinois, USA.

Ngai V, Schwenke T, Andriacchi TP and Wimmer MA. (2006) "Kinematics of total knee replacement (TKR) patients versus knee simulator input data." *5th World Congress of Biomechanics*: July 30-Aug 4, Munich, Germany.

Teichroeb JH, Forrest JA and **Ngai V**. (2006) "Thermal Stability, and Curvature Dependence of Bovine Serum Albumin on Gold Nanoparticles Using Localized Surface Plasmon Resonance." *2006 American Physical Society March Meeting*: March 13-17, Baltimore, MD, USA.

Ngai V, Medley JB and Jones L. (2004) "Friction of Contact Lenses: Silicone and Conventional Hydrogels." *World Biomaterials Congress*: May 17-21, Sydney, Australia.

Ngai V, Medley JB, Jones L, Forrest J and Teichroeb J. (2004) "Measurement of Friction Associated with Lotrafilcon and Hema Hydrogel Contact Lenses." *International Conference on the Lacrimal Gland, Tear Film, Ocular Surface and Dry Eye Syndromes: Basic Science and Clinical Relevance*: November 17-20, Fajardo, Puerto Rico

Teichroeb JH, Martin J, Forrest JA, Jones LW, **Ngai V**, Medley J. (2004) "SEM and AFM Imaging of Contact Lens Spoilation." *International Conference on the Lacrimal Gland, Tear Film, Ocular Surface and Dry Eye Syndromes: Basic Science and Clinical Relevance*: November 17-20, Fajardo, Puerto Rico

Ngai V, Medley JB, Jones L, Forrest J and Teichroeb J. (2004) "Influence of In-Vitro Protein Deposition on Friction of Hydrogel Contact Lens Materials." *Society for Biomaterials-30th Annual Meeting & Exposition*: April 27-30, Memphis, Tennessee, USA

Ngai V, Medley JB, Jones L, Forrest J and Teichroeb J. (2005) "Friction Simulation of the Anterior Surface of Hydrogel Contact Lenses." *Canadian Biomaterials Society-24th Annual Meeting*: May 26-28, Waterloo, Ontario, Canada

Teichroeb J, **Ngai V**, Forrest J and Jones L. (2005) "Thermal Stability of Lysozyme Adsorbed onto Gold Nanoparticles." *Canadian Biomaterials Society-24th Annual Meeting*: May 26-28, Waterloo, Ontario, Canada

SERVICE TO A PROFESSIONAL ORGANIZATION

2019 to present Crossfit 88, Lead Coach

2018 to present CRC Press Books-Forensic Science, Reviewer

2016 to present Orthopaedic Research Society, Reviewer

2016 to present International Journal of Biomedical Engineering and Technology, Reviewer

2011 to 2017 Crossfit Rise, Lead Coach

2011 to 2014 Crossfit Chicago, Lead Coach

INVITED LECTURES AND SEMINARS

Notre Dame, Department of Aerospace and Mechanical Engineering, AME 40572/60572 Introduction to Biomechanics, April 26, 2021, "Forensic Biomechanics"

Virginia Tech, College of Engineering, Biomedical Engineering and Mechanics, BEAM Career Exploration Seminar Series, March 5, 2021, "Forensic Biomechanics"

Worcester Polytechnic Institute, Department of Biomedical Engineering, BME 4504 Biomechanics, March 4, 2021, "Forensic Biomechanics"

University of Illinois at Chicago, Department of Bioengineering, BIO 594 Biomedical Implants, October 26, 2020, November 18, 2019, October 22, 2018, "Forensic Bioengineering – Biomechanics and Biotribology"

Northwestern University, Feinberg School of Medicine, Department of Ophthalmology, April 10, 2020, "Forensic Biomechanics and Maxillofacial Trauma" – Visiting Professor Lecture for Grand Rounds and Resident Didactics

Loyola University Chicago, Department of Engineering Science, ENGR 101 Introduction to Engineering Design, September 25, 2019, "Forensic Bioengineering – Biomechanics and Biotribology"

University of Waterloo, Department of Mechanical and Mechatronics Engineering, ME 706 Advanced Tribology, November 10, 2016, "Application of Tribology"

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Messiah College, School of Science, Engineering and Health, March 3, 2016, "Introduction to Tribology"

Crossfit Rise, August 9, 2014, "Basic Biomechanics of Human Motion"

Crossfit Chicago, November 11, 2014, "Basic Biomechanics of Human Motion"

Rush University Medical Center, 2013, "Forensic Biomechanics"

University of Waterloo, May 17, 2012, "Forensic Biomechanics"

HONORS

- 2019 International Society for Technology in Arthroplasty, HAP Paul Award
- 2008 to 2009 FMC Technologies, Inc. Fellowship Award
- 2007 to 2008 University of Illinois at Chicago – T. P. and D. B. Andriacchi Endowed Fellowship
- 2006 Society of Tribologists and Lubrication Engineers Scholarship
- 2006 University of Illinois at Chicago – Women in Science and Engineering Award
- 2004 University of Waterloo Teaching Assistant Award

EXPERT NOT RETAINED