THE EXPERTS
Robson Forensic

RAVI R. PATEL, Ph.D.
Biomedical Engineer/ Biomechanics and Medical Devices

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 (e.g. shoulders, knees, ankles, elbows), soft tissues (e.g. tendons, ligaments, nerves), and fracture patterns (e.g. torso, long bone, hand, foot, skull)

Determines Cause: Applying engineering principles, determines:

- The manner in which a tissue failed: the type of loading, the direction of loading and magnitude or size of the load that caused the injury.
- If the mechanical cause of diagnosed injury patterns is 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 workplace injuries.
- Sports and recreational injuries.

PROFESSIONAL EXPERIENCE

2026 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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2019 to 2026 **Align Technology**
Senior R&D Engineer

- Developed novel orthodontic appliances for the treatment of dental malocclusions used for treatment in thousands of patients to date.
- Developed testing protocols and applied kinematics and kinetics of the human mandible in simulation testing to develop orthodontic appliances.
- Performed benchtop and computational biomechanical analyses of novel orthodontic devices to assess patient safety and device efficacy.
- Created automated data analysis pipelines for CT images to assess orthopedic motion of the mandible during treatment with various orthodontic appliances.
- Provided guidance and specialized biomechanical knowledge to direct multi-team collaboration involving software, manufacturing, clinical affairs, treatment planning, FDA compliance, and quality assurance for implementation and launch of new medical devices.
- Interfaced with orthodontists and dentists for clinical and pilot studies of novel applications of orthodontic appliances.
- Performed failure analysis and root cause evaluation for patient and orthodontist complaints.
- Supported IRB and FDA submissions for new medical device approval for market.
- Established new doctor and patient instructions for use when developing new applications for orthodontic appliances

2014 to 2019 **University of Colorado**
Research Assistant *2016-2019*

- Characterized mechanical behavior of various patient-specific spinal fusion cage designs and their impact on vertebral stresses to identify methods to reduce patient side effects and recurrent surgery.
- Developed testing methodologies for characterizing mechanical properties of vertebral endplates.
- Evaluated mechanical and material properties of biomaterials used in orthopedic applications using various analysis methods (e.g. SEM, DMA, CT, Uniaxial Testing, DSC).
- Assessed damping and shock absorbing behavior of liquid crystal elastomers for applications in vertebral disc replacements, total knee replacement, and football helmets.
- Authored multiple interdisciplinary publications integrating materials science, shape memory polymers, medical devices and finite element analysis.

Teaching Assistant *2014-2016*

- Graded papers, reports, exams, and conducted tutorials as a teaching assistant for Introduction to Materials Science (MECH 2024) on the properties, processing, and structure of engineering materials.

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2018 **K1C Consulting**
Consulting Engineer
- Provided biomechanical analysis for clients (orthopedic device companies) to compare device performance in comparison to competitor devices under gait loading.
- Developed 3D models and prototypes to represent human fingertip and nail properties.

2017 to 2018 **Furman IP Law**
National Science Foundation (NSF) Intern for Intellectual Property
- Under the supervision of the practicing attorney, drafted invention disclosures and patent claims.
- Conducted prior art searches and research regarding client inventions to assess patentability and claim scope.

2010 to 2012 **MedShape Orthopedics (Aquired by Enovis)**
Research and Development Co-op
- Created and modeled surgical implant and instrument designs for shoulder, foot/ankle, and knee orthopedic procedures.
- Conducted performance testing of soft tissue anchorage devices in human cadavers.
- Assessed range of motion in cadaveric specimens before and after ACL repair with various orthopedic implants.
- Characterized bone and tendon failure mechanisms via benchtop testing to assess device performance during verification and validation process for market approval.
- Synthesized and characterized material properties and mechanical behavior of shape memory polymers for use in orthopedic applications.
- Collaborated with orthopedic surgeons to gather feedback on instrument and implant design through cadaver labs.

EDUCATION

Ph.D., Engineering and Applied Sciences, University of Colorado, Denver, Colorado
B.S., Biomedical Engineering, Georgia Institute of Technology, Atlanta, Georgia

PROFESSIONAL MEMBERSHIPS

Orthopedic Research Society (ORS)

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PUBLICATIONS

Dissertation:

Patel, R. R. (2018) Does Patient-Specific Implant Design Reduce Subsidence Risk in Lumbar Interbody Fusion? A Bottom Up Analysis of Methods to Reduce Vertebral Endplate Stress, Doctoral Dissertation, University of Colorado-Denver.

Refereed Journal Publications:

Terrill, P.*, **Patel, R. R.***, Pacaccio, D., Dupont, K., Safranski, D., Yakacki, C., Carpenter, D. (2023). Effect of intramedullary nail stiffness on load-sharing in tibiotalocalcaneal arthrodesis: A patient-specific finite element study. PLOS ONE, 18(11), e0288049. https://doi.org/10.1371/journal.pone.0288049 (*indicates co-first author)

Shaha, R. K., Merkel, D. R., Anderson, M. P., Devereaux, E. J., **Patel, R. R.**, Torbati, A. H., Willett, N., Yakacki, C. M., Frick, C. P. (2020). Biocompatible liquid-crystal elastomers mimic the intervertebral disc. Journal of the Mechanical Behavior of Biomedical Materials, 107, 103757. https://doi.org/10.1016/j.jmbbm.2020.103757

Volpe, R. H., Mistry, D., Patel, V. V., **Patel, R. R.**, Yakacki, C. M. (2020). Dynamically crystalizing liquid-crystal elastomers for an expandable endplate-conforming interbody fusion cage. Advanced Healthcare Materials, 9(1), 1901136. https://doi.org/10.1002/adhm.201901136

Patel, R. R., Noshchenko, A., Dana Carpenter, R., Baldini, T., Frick, C. P., Patel, V. V., Yakacki, C. M. (2018). Evaluation and prediction of human lumbar vertebrae endplate mechanical properties using indentation and computed tomography. Journal of Biomechanical Engineering, 140(10), 101011. https://doi.org/10.1115/1.4040252

Ahn, H.*, **Patel, R. R.***, Hoyt, A. J., Lin, A. S. P., Torstrick, F. B., Guldberg, R. E., Frick, C. P., Carpenter, R. D., Yakacki, C. M., Willett, N. J. (2018). Biological evaluation and finite-element modeling of porous poly (Para-phenylene) for orthopaedic implants. Acta Biomaterialia, 72, 352–361. https://doi.org/10.1016/j.actbio.2018.03.025 (*indicates co-first author)

Ula, S. W., Traugutt, N. A., Volpe, R. H., **Patel, R. R.**, Yu, K., Yakacki, C. M. (2018). Liquid crystal elastomers: An introduction and review of emerging technologies. Liquid Crystals Reviews, 6(1), 78–107. https://doi.org/10.1080/21680396.2018.1530155

Collins, D. A., Yakacki, C. M., Lightbody, D., **Patel, R. R.**, Frick, C. P. (2016). Shape-memory behavior of high-strength amorphous thermoplastic poly (para -phenylene). Journal of Applied Polymer Science, 133(3), app.42903. https://doi.org/10.1002/app.42903

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Refereed Published Abstracts and Conference Presentations:

Ahn, H.; **Patel, R.R.,** Hoyt, A., Lin, A., Trostrick, B., Guldberg, R., Frick, C.P., Carpenter, R.D., Yakacki, C.M. (2017) Load Sharing and Mechanical Strength of Bone Ingrowth in Porous Poly (para-phenylene) scaffolds, International Materials Research Congress (2017)

Patel, R. R.; Noshchenko, A., Carpenter, R. D., Baldini, T., Frick, C. P., Patel, V. V., Yakacki, C. M. (2017) Evaluation and Prediction of Human Lumbar Vertebra Endplate Mechanical Properties Using Indentation and Computed Tomography. Orthopedic Research Society Poster Session (2017)

PATENTS

Methods and apparatuses including tooth eruption prediction, patent # US20240216106A1, pending

Occlusal blocks for dental appliances and methods for making same, patent # US20250387199A1, pending