

# Patrick M. Williamson

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## Research Experience

### **Mechanical Engineering | PhD Student**

**Center for Advanced Orthopaedic Studies | Department of Orthopaedic Surgery  
Beth Israel Deaconess Medical Center, Harvard Medical School (Boston, MA)**

August 2016 – Present

Assist with prototyping parts, designing models, and carrying out studies of various biomechanical and surgical cadaveric evaluations of the hand, knee, shoulder, elbow, foot and ankle. Notable projects include:

#### Implementation of Variable Muscle Loading for a Shoulder Biomechanics Testing System

(October 2014 – Present)

- Integrated variable muscular forces and kinematic signals into a robotic testing system to investigate shoulder pathologies through evaluation of glenohumeral kinetics and subacromial contact pressures.
- Implemented dynamic loading of shoulder cuff muscles to more physiologically evaluate biomechanics, physiology and various morbidities concerning the shoulder complex.
- Applied six degree of freedom electromagnetic sensors to track the three-dimensional motion of anatomical landmarks and record glenohumeral kinematics in shoulder motion

→ *Mentors:* Ara Nazarian PhD, Joseph P. DeAngelis MD/MBA, Arun J. Ramappa MD, Edward K. Rodriguez MD/PhD, Naven Duggal MD

### **Biomedical Engineer | Research Technician**

**Center for Advanced Orthopaedic Studies | Department of Orthopaedic Surgery  
Beth Israel Medical Deaconess Center, Harvard Medical School (Boston, MA)**

October 2014 – August 2016

#### Biomechanical Analysis of Ankle and Subtalar Joint Contact Pressures in Hindfoot Injury and Repair

(November 2015 - Present)

- Implemented static loading of the lower extremity to evaluate biomechanics, physiology and various morbidities concerning the hindfoot in the cadaveric setting
- Evaluated the effect of different simulated pathologies on the intraarticular pressures
- Performed data analysis and co-wrote the manuscript to report the findings for these studies

#### Biomechanical Analysis of Tibiofemoral Contact Pressures After Novel Repair of Meniscus Horizontal Cleavage Tears

(November 2015 - Present)

- Evaluation of the ability of an all-inside horizontal meniscal cleavage tear repair system to restore tibiofemoral contact pressures to that of the intact meniscus via axial loading at varying degrees of tibiofemoral flexion.
- Study the efficacy of this repair, as compared to current treatment options, in order to present a viable method for meniscal preservation and ultimately, joint preservation.

#### A Comparative Biomechanical Study of the Surgical Reconstruction of the Scapholunate Ligament

(October 2014 – Present)

- Determine the feasibility of performing capsulodesis, tendodesis, and front-back looping surgical repair methods to correct ruptured scapholunate ligaments within wrist cadaveric models using pre-operative and post-operative radiography.
- Design and construct a variable muscle loading wrist motion simulator enabled for cadaveric biomechanical testing and surgical repair/outcome studies.
- Evaluate the biomechanical utility and surgical repair efficacy of scapholunate ligament repair methods using a novel, variable muscle loading wrist motion simulator.

#### Utility of Cortical Bone Tissue Properties in the Assessment of Fracture Risk

(November 2015 – present)

- Assisted in determining whether women with wrist and hip fractures have altered cortical bone tissue properties, as assessed *in vivo* by a new minimally invasive approach called reference point indentation, compared to age-matched controls without fractures.

### Records Associate

#### Bionic Pancreas Clinical Trials, Damiano Laboratory (BU) and Beta Bionics | Boston University College of Engineering (Boston, MA)

June 2015 – August 2016

- Monitored patients and Bionic Pancreas systems in real-time via remote telemetry to ensure patient safety for a total of 12 weeks covering 16 patients who were enrolled in a double-blinded, randomized crossover clinical trial
- Coordinated with 24/7 monitoring and triage teams to communicate and resolve issues as they arose

### Research Assistant

#### Department of Chemistry | Boston University (Boston, MA)

March 2013 – August 2014

Urinary Tract Infection identification and evaluation through the use of Surface Enhanced Raman Spectroscopy (SERS)

- Implement laser microscopy to capture vibrational spectra of model compounds, cancer cells, and bacterial cells
- Cross-referenced bacterial vibrational spectra at given times with KEGG purine metabolism pathway
- Investigated the Warburg Effect and the metabolites involved in cancer cell metabolism

### Education

Boston University – College of Engineering

Expected Graduation -May 2021

Ph.D. Mechanical Engineering

Boston University – College of Engineering

May 2016

B.S. Biomedical Engineering

### Peer-reviewed Publications, Abstracts and/or Presentations

1. **Williamson P**, Lechtig A, Hanna P, et al. Pressure Distribution in the Ankle and Subtalar Joint With Routine and Oversized Foot Orthoses. *Foot Ankle Int* 2018;1071100718770659. doi: 10.1177/1071100718770659.

2. **Williamson PM**, Harlow E, Lechtig A, Hanna P, Okajima S, Nasr M, Biggane P, Duggal N, Nazarian A. The Effect of Achilles Tendon Lengthening on Ankle and Subtalar Joint Orientation and Load Distribution Utilizing a Novel System to Simulate Weight Bearing in a Cadaveric Model. *American Orthopaedic Foot and Ankle Society Conference* (2018), Boston, MA. Poster Presentation.

3. **Williamson PM**, Harlow E, Lechtig A, Hanna P, Okajima S, Nasr M, Biggane P, Duggal N, Nazarian A. A Computer Assessment of the Effect of Hindfoot Alignment on Mechanical Axis Deviation and Ankle Fractures. *American Orthopaedic Foot and Ankle Society Conference* (2018), Boston, MA. Poster Presentation

4. Systemic Distribution of Relaxin-2 After a Single Intra-articular Injection: A Pharmacokinetic Pilot Study. **Williamson PM**, Cubria M, Okajima S, Blessing W, Hanna P, Lechtig, A, Sobogal, A, Grinstaff, M, Rodriguez E, Nazarian A. *Harvard Orthopaedic Trauma Initiative*. Poster Presentation.

5. Anisotropy-Restoring Femoroplasty: A Novel Device for Prophylactic Prevention of Low- Energy Hip Fracture. Egan J, **Williamson P**, Hanna P, Lechtig A, Okajima S, Rodriguez E, Nazarian A. *Harvard Orthopaedic Trauma Initiative*. Poster Presentation.

6. Cho J, Nag V, Nordsteen L, **Williamson PM**, Nazarian A. Modelling Mechanical & Biological Properties of Tendon Tear Progression In-Vivo. *Northeast Bioengineering Conference* (2018), Philadelphia, PA. Poster Presentation.

7. Premasiri WR, Chen Y, **Williamson PM**, Bandarage DC, Pyles C, Ziegler LD. Rapid urinary tract infection diagnostics by surface-enhanced Raman spectroscopy (SERS): identification and antibiotic susceptibilities. *Anal Bioanal Chem* 2017;409(11):3043-3054. doi: 10.1007/s00216-017-0244-7

8. Okajima SM, Cubria MB, **Williamson P**, Villa-Camacho J, Perez-Viloria M, Suarez S, Flynn E, Warman M, Grinstaff M, Rodriguez EK, Nazarian A. Loosening Stiff Joints by Intra-articular Injection of Relaxin-2. *Orthopedic Research Society 2018 ORS Conference* (New Orleans, Louisiana).

9. Lechtig A, **Williamson PM**, Hanna P, Okajima S, Biggane P, Nasr M, Duggal N, Nazarian A. The Effect of Orthotics on Ankle and Subtalar Joint Orientation and Load Distribution Utilizing a Novel System to Simulate Weight Bearing in a Cadaveric Model. American Orthopaedic Foot and Ankle Society Conference 2017 (Seattle, Washington)
10. Ghorbanhoseini, M, Suryavanshi, T, **Williamson, P**, Sahakian, L, Hafezi, P, Yazdi, H, Kwon, J, Nazarian, A. Short Term Results of ACL Augmentation in Professional and Amateur Athletes. Orthopedic Research Society 2017 ORS Conference (San Diego, California).
11. Egan, J, Kachooei, A, Hamparian, K, **Williamson, P**, Nazarian, A. Bilateral Arm-Abduction Shoulder Radiography to Determine the Involvement of the Scapulothoracic Motion in Frozen Shoulder. Orthopedic Research Society 2017 ORS Conference (San Diego, California).
12. Ghorbanhoseini, M, Suryavanshi, T, Copeland, D, **Williamson, P**, Egan, J, Hafezi, P, Yazdi, H, Nazarian, A. Does Triple Semitendinosus Autograft Tendon Have the Same Thickness as Quadrupled Semitendinosus and Gracilis Autograft Tendons in ACL Reconstruction? Orthopedic Research Society 2017 ORS Conference (San Diego, California).
13. Ajbani AP, **Williamson PM**, Wong AC, Cubria M.1; Suarez S, Egan J, Okajima S, Liu C, Walley KC, Perez M, Nasr M, Ramappa AJ, DeAngelis JP, Ludewig P, Nazarian A. Clinical Validation of Kinetics and Kinematics of the Glenohumeral Joint in Abduction. Northeast Bioengineering Engineering Conference 2016. (Binghamton, New York)
14. Walley KC, Harlow ER, **Williamson PM**, Nasr MC, Okajima SM, Perez-Viloria ME, DeAngelis JP, Nazarian A, Ramappa AJ. The Effect of the Rotator Interval on Glenohumeral Kinematics During Abduction. Orthopedic Research Society 2016 ORS Conference (Orlando, Florida).
15. Nasr M, Harlow ER, Walley KC, **Williamson PM**, Okajima SM, Ramappa AJ, DeAngelis JP, Nazarian A. Glenohumeral Joint Kinematics Following Shortened Clavicular Malunion. Orthopedic Research Society 2016 ORS Conference (Orlando, Florida).
16. Harlow ER, Walley KC, **Williamson PM**, Nasr MC, MD, Okajima SM, Perez-Viloria ME, MD, Nazarian A, PhD, Ramappa AJ, MD, DeAngelis JP, MD, MBA. (2016) A Biomechanical Evaluation of Type II and Type III Acromioclavicular Joint Injuries. Orthopedic Research Society 2016 ORS Conference (Orlando, Florida).
17. **Williamson PM**, Okajima S.M, Harlow E.R, Walley K.C, Masoudi A, MD, Perez-Viloria ME, MD; Nasr MC, MD, Wexler M, Hertz B., Patel N., Ramappa A.J., MD, DeAngelis J.P., MD, MBA, Nazarian A., PhD. The Effect of Capsular Integrity On Glenohumeral And Subacromial Forces And Kinematics In A Cadaveric Model Of Abduction With Variable Loading. Biomedical Engineering Society 2015 BMES Conference (Tampa, Florida).
18. Rajan PV, Okajima S, Walley KC, Perez-Viloria M, MD, Nasr MC, MD, Manoukian OS, MD, **Williamson PM**, Nazarian A, PhD, Day CS, MD, MBA. A comparative biomechanical study of the scapholunate interosseous ligament. Harvard Medical School Soma Weiss Day (2015).
19. **Williamson PM**, Premasiri ,RP, PhD, Chen Y, Ziegler, LA, PhD. Novel Method for Identifying Urinary Tract Infection Using Surface Enhanced Raman Spectroscopy (SERS). Boston University Undergraduate Research Opportunity Program Research Symposium (2014).
20. DelMonaco A, **Williamson PM**, Premasiri ,RP, Chen Y, Ziegler, LA. Understanding Metabolism and the Warburg Effect of Cancer Cells Through the Use of Surface Enhanced Raman spectroscopy (SERS) Department of Chemistry, Boston University, Boston MA, USA (2013)

## Additional Experience

### **President, Boston University Biomedical Engineering Society (Boston, MA)**

- Organize meetings to bring together the Biomedical Engineering community of Boston University especially in interest of graduate school, medical school, and industry.
- Attend conferences and relevant meetings to bring knowledge and connections back to the club.

### **President, Boston University Club Baseball (Boston, MA)**

- Organize intercollegiate club baseball games including scheduling, umpire coordination and coordinate travel for team members. Additionally, I have taken responsibilities with equipment purchases, team finances, and alumni relations.

**Volunteer Activities**, Boston Marathon Volunteer (BAA), One Walk for Type 1 Diabetes, Senior Center (Bellingham, MA), The Adoption Clinic of Bellingham (Bellingham, MA), Part-time Assistant Coach for AAU and interscholastic youth baseball teams (seasonal).

**Skills**

**Laboratory:** Polhemus Liberty Tracking System, Arduino, TekScan Pressure Mapping, Qualysis ProReflex High Speed Camera Motion Capture, Instron Mechanical Loading, Bacterial culture, gel electrophoresis, Real Time RT-PCR/PCR, Static Cell Adhesion Assays, Spectra Acquisition with Surface Enhanced Raman Spectroscopy Microscope (SERS), Spectra Acquisition with Optical Density Spectrometer, Investigative analysis of spectra in Grams AI and MATLAB

**Technical:** MATLAB, ANSYS, SolidWorks, Grams AI, Wire 2.0, SpectraSuite, MS-Word, MS-Access, MS-Excel, MS-Visio, MS-PowerPoint

**Honors & Activities**

- Biomedical Engineering Society (BMES) National Member since 2012
- Boston University Grant Recipient
- Undergraduate Research Opportunity Program Research Funding Recipient; Summer 2014 and Summer 2015
- Boston Park League Baseball, TJO Sports 2018
- Boston University Club Baseball President Spring 2014 to Spring 2016
- Theta Tau Chapter of Boston University Active Member since Spring 2014
- First Year Student Outreach Program (FYSOP) at Boston University
- Boston Half Marathon (BAA) Finisher Fall 2015
- Boston Marathon (BAA) annual volunteer since 2013