

# Sarah Howe McBride-Gagy

SMcBride82@gmail.com

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## PERSONAL PROFILE

Ph.D. Biomedical Engineer with over 11 years of academic and industrial research experience. Specializes in biomechanics and bone repair/regeneration. Develops diverse experimental protocols and analysis software. Also has over 10 years of teaching, training, and mentoring experience.

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## RESEARCH HIGHLIGHTS

- Established a link between reduction of BMP2 in osteoblasts/osteocytes and bone fragility. Currently investigating possible roles of BMP2 in bone quality.
- First to characterize the anisotropic material properties of ovine femoral periosteum
- Received top speaker awards at conferences sponsored by the Society for Biomaterials and NIH funded Musculoskeletal Research training center
- 2007 NSF Graduate Student Research Fellowship honorable mention
- NIH Pre-doctoral T32 Training Fellow
- NIH Post-doctoral T32 Training Fellow

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## EDUCATION

**Ph.D. Biomedical Engineering** January 2011

Case Western Reserve University (CWRU), Cleveland, OH  
Dissertation: The mechanical environment of the periosteum during healing  
Adviser: Dr. Melissa L. Knothe Tate

**M.S. Biomedical Engineering**, CWRU, Cleveland, OH **GPA: 3.89/4.0** January 2008

Thesis: Elucidating biophysical cues conducive to targeted stem cell differentiation  
Adviser: Dr. Melissa L. Knothe Tate

**B.S. Mechanical Engineering**, Clemson University, Clemson, SC **GPA: 3.89/4.0** December 2004

**Magna Cum Laude with Honors, Co-op 3 Semesters**  
Honors Thesis: Unsteady heat transfer predictions using computational fluid dynamics (CFD) to turbulent flow past a single rib; evaluation of unsteady RANS methodology  
Adviser: Dr. James H. Lylek

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## ACADEMIC RESEARCH EXPERIENCE

**Assistant Professor**, Saint Louis University (SLU), St. Louis, MO February 2014-Present  
Department of Orthopedic Surgery  
Skeletal Mechanobiology, Biomechanics, and Tissue Engineering Laboratory

**Volunteer Visiting Professor**, Washington University in St. Louis (WUSTL), St. Louis, MO February 2014-Present  
Department of Orthopedics

**Adjunct Assistant Professor**, SLU, St. Louis, MO June 2013-January 2014  
Department of Orthopedic Surgery  
Skeletal Mechanobiology, Biomechanics, and Tissue Engineering Laboratory

- Write IACUC and IBC Protocols
- Set up a mechanics and cell culture lab

**Postdoctoral Research Associate**, WUSTL, St. Louis, MO February 2011-January 2014

Department of Orthopedics  
Skeletal Mechanobiology & Biomechanics Laboratory

- Phenotype conditional knockout mice using DEXA and *in vivo* microCT
- Establish knockout validation studies that utilize FACS sorting, qPCR, cre reporter mice, and immunohistochemistry
- Ascertain mechanical loading parameters to induce stress fractures in wild type and conditional knockout mice
- Determine differences in bone healing via microCT and dynamic histomorphometry

**Doctoral Research**, CWRU, Cleveland, OH & Davos, Switzerland

January 2008- Jan. 2011

Biomedical Engineering

Experimental and Computational Mechanobiology Laboratory

- Developed and implemented multi-scale, optical displacement and strain measurement software in MatLab
- Prepared IACUC protocols
- Conducted the first material properties studies of ovine periosteum
  - Revealed that ovine femoral periosteum is highly anisotropic & prestressed, but the differences are only evident in high strain scenarios (*i.e.* significant trauma)
- Determined that slow cryopreservation does not affect the elasticity of ovine periosteum
- Researched the relationship between periosteal strain and early bone formation
  - Conducted 3 months of *ex vivo* ovine femora tests at the AO Research Institute in Davos, Switzerland
  - Observed a correlation between bone formation and both tensile and compressive periosteal strain

**Masters Research**, CWRU, Cleveland, OH

August 2005- January 2008

Biomedical Engineering

Experimental and Computational Mechanobiology Laboratory

- Analyzed the effects of seeding density, three-dimensional structure, and applied shear stress on the expression of genes related to initial steps of skeletalgenesis by stem cells
  - Stem cells are remarkably sensitive to mechanical environment and mechanical stimulation.
  - Gene modulation occurs with as little as 0.2 dynes/cm<sup>2</sup> of shear stress in as little as 30 min
- Modeled (MatLab) and verified (confocal microscopy) the multi-layer cell constructs achievable through different seeding protocols
- Characterized the proliferation of a stem cell line

## INDUSTRIAL RESEARCH & EXPERIENCE

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**Research and Development Engineer**, Rockwell Automation, Greenville, SC

February 2005 -July 2005

Power Systems Division - Bearings

- Conducted fatigue/quality assurance testing on procured bearing cages, environmental corrosion testing on competitor bearings, and destruction testing on new bearing-shaft interface designs

**Research Assistant**, General Electric, GE Global Research Center, Niskayuna, NY

Summer 2004

Energy and Propulsion Technologies – Performance Technology Lab

- Developed and executed harsh environment tests to assure the tensile strength integrity of the Kevlar fibers used in the GENx airplane engine rotor bearing oil seals

**Mechanical Engineer**, General Electric, GE Power Systems Steam Turbines, Schenectady, NY

Summer 2003

Accessory Systems Engineering – Fluid Systems Division

- Adapted accessory systems' mechanical drawings per customer order and destination country regulation
- Assured compliance with EU and Chinese government regulations

**Mechanical Engineer**, General Electric, GE Power Systems Gas Turbines, Greenville, SC

Spring 2002

New Product Introduction – Hot Gas Path Design

- Modeled common manufacturing errors of stage one turbine blades in ANSYS
- Salvaged over \$1 Million of blades previously thought unusable

## TEACHING EXPERIENCE

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**Assistant Professor**, SLU, St. Louis, MO Spring 2014 to Present  
 Orthopedic Surgery Grand Rounds

**Adjunct Assistant Professor**, SLU, St. Louis, MO Falls 2012 & 2013  
 Biomedical Engineering Department

- Taught BME 450: “Numerical Methods for Biomedical Engineering” to undergraduate and graduate students.
- Incorporated MATLAB coding to solve large linear, non-linear, ordinary differential equations, and partial differential equations using traditional numerical methods

**Private Math, Statistics, Physics, and Test Preparation Tutor**, University Tutors.com & Wyzant.com 2010-2014

- Create personalized 4-6 session curricula to address each student’s strengths and weaknesses for the SAT and ACT
- Provide tailored support and supplemental instruction for math, statistics, and physics for high school, undergraduate, and graduate level classes.

**Test Preparation & Mathematics Instructor**, Townsend Learning Center, Cleveland, OH 2008-2010  
 SAT/ACT Preparatory Class

- Team taught an 8 session course for 30-40 high school juniors
- Adapted and taught curriculum covering general test strategy, math, and science

Real Estate Appraisal Summer 2009

- Created and taught a 24 session curriculum covering financial math, algebra, and geometry for real estate appraisal

**Teaching Assistant/Lecturer**, CWRU, Cleveland, OH

School of Engineering Fall 2005

Introduction to Biomedical Engineering Fall 2005

Thermodynamics, Fluid Dynamics, Heat & Mass Transfer Fall 2006 & Fall 2007

## HONORS AND AWARDS

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**Harold M. Frost Award** 2013  
*International Bone and Mineral Society*

**NIH Metabolic Skeletal Disorders Training Grant** July 2011-January 2014  
*Postdoctoral Fellow*

**2<sup>nd</sup> Place Overall Oral Presentation** November 6, 2010  
*2010 Joint Meeting of the Society for Biomaterials (CWRU, University Kentucky, Purdue)*

**Best Predoctoral Oral Presentation** March 24, 2010  
*CWRU NIH Musculoskeletal Research Day*

**NIH Musculoskeletal Training Grant** January 2008-January 2011  
*Predoctoral Fellow*

**NSF Graduate Research Fellowship** 2007  
*Honorable Mention*

**Medtronic Innovation Incentive Fellowship** Academic Year 2006-2007  
*Predoctoral Fellow*

**NSF ACES ADVANCE Award** Summer 2006  
*Predoctoral Fellow*

## LEADERSHIP EXPERIENCE

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- Orthopaedic Resident Research Mentor**, SLU, Orthopedic Surgery, St. Louis, MO June 2013-Present
- Supervise and mentor one Orthopaedic Surgery Resident per year in a basic science project.
- Undergraduate Student Research Mentor**, WUSTL, Orthopedic Surgery, St. Louis, MO Summers 2011, 2012, 2013
- Supervise and mentor one undergraduate student in summer research projects
- Outreach Volunteer**, Society of Women Engineers – St. Louis Chapter, St. Louis, MO 2011-Present
- Participate in day-long programs to introduce youth to engineering
- Girl's Science Club Volunteer**, CWRU, Women in Science and Engineering Roundtable, Cleveland, OH 2010-2011
- Lead groups of underprivileged junior high school girls through a weekly after-school activity designed to promote science and engineering
- Philanthropy Chair**, CWRU, Biomedical Engineering Graduate Student Association (GSA), Cleveland, OH 2008-2010
- Co-ordinated and organized 4-6 community service activities per academic school year for 25 graduate student volunteers with organizations such as Ronald McDonald House, The Upside of Downs of Greater Cleveland, and the American Cancer Society
  - Served as the tissue engineering representative on the graduate student executive board
- Prospective Graduate Student Recruitment**, CWRU, Biomedical Engineering GSA, Cleveland, OH 2006-2011
- Co-ordinated tours, information sessions, and social events for 40 prospective graduate students to introduce them to the research opportunities and community of both Case Western Reserve University and greater Cleveland.
- Group Facilitator – STEM Curriculum**, CWRU, Biomedical & Mechanical Eng., Cleveland, OH 2006-2011
- Lead groups of middle school girls through a series of activities designed to promote Science, Technology, Engineering, and Math (STEM) Curriculum for Underrepresented Groups developed by and under the leadership of Dr. Melissa Knothe Tate.
- Undergraduate Student Research Mentor**, CWRU, Biomedical & Mechanical Eng., Cleveland, OH 2006-2011
- Supervised and mentored 1-3 undergraduate students each semester in research projects and senior projects
- Prospective Undergraduate Student Recruitment**, Clemson University, Mech. Engineering, Clemson, SC 2001-2004
- Led tours of 100+ prospective undergraduate students to introduce them to the physics, industrial engineering, and mechanical engineering departments.
- Camp Counselor**, Montgomery Camp and Conference Center, Starke, FL Summer 2001 & 2002
- Oversaw the camp activities of 8-12 campers for 1-2 weeks of residential camp
  - Certified to facilitate high ropes, wall climbing, challenge courses, and archery

## PUBLICATIONS

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**McBride-Gagyi SH**, McKenzie JA, Buettmann EG, Gardner MJ, Silva MJ. (2015) BMP2 conditional knockout in osteoblasts and endothelial cells does not impair bone formation after injury or mechanical loading in adult mice. *Bone* September 5: pii: Epub ahead of print.

**McBride SH**, McKenzie JA, Bedrick BS, Kuhlman P, Pasteris JD, Rosen V, Silva MJ. (2014) Long bone structure and strength depend on BMP2 from osteoblasts and osteocytes, but not vascular endothelial cells. *PLoS One*. 9(5):e96862.

**McBride SH** & Silva MJ. (2012) Adaptive and injury response of bone to mechanical loading. *BoneKEY Osteovision*, 10(1): pii:192

Song MJ, Brady-Kalnay SM, **McBride SH**, Phillips-Mason P, Dean D, Knothe Tate ML. (2012) Mapping the mechanome of live stem cells using a novel method to measure local strain fields *in situ* at the fluid-cell interface. *PLoS One*, 7(9): e43601

**McBride SH**, Evans SF, Knothe Tate ML (2011) Anisotropic mechanical properties of ovine femoral periosteum and the effects of cryopreservation. *Journal of Biomechanics*, 44(10): 1954-1959.

Knothe Tate ML, Dolejs S, **McBride SH**, Miller RM, Knothe U. (2011) Multiscale mechanobiology of *de novo* bone generation, remodeling and adaptation of autograft in a common ovine femur model. *Journal of Mechanical Behavior of Biomedical Materials*, 4 (6): 829-840.

**McBride SH**, Dolejs S, Knothe U, Knothe Tate ML (2011) Major and minor centroidal axes serve as objective, automatable reference points to test mechnobiological hypotheses using histomorphometry. *Journal of Biomechanics*, 44(6): 1205-1208.

**McBride SH**, Dolejs S, Brianza S, Knothe U, Knothe Tate ML (2011) Net change in strain during stance shift loading after surgery correlates to rapid *de novo* bone generation in critically sized defects. *Annals of Biomedical Engineering*, 39(5): 1570-1581.

**McBride SH**, Knothe Tate ML (2008) Modulation of stem cell shape and fate A: The role of density and seeding protocol on nucleus shape and gene expression. *Tissue Engineering Part A*, 14(9): 1561-1572.

**McBride SH**, Falls TD, Knothe Tate ML (2008) Modulation of stem cell shape and fate B: Mechanical modulation of cell shape and gene expression. *Tissue Engineering Part A*, 14(9): 1573-1580.

Knothe Tate ML, Falls TD, **McBride SH**, Atit R, Knothe UR. (2008) Mechanical modulation of osteochondroprogenitor cell fate. *International Journal of Biochemistry and Cell Biology*, 40(12):2720-2738.

#### SELECTED INTERNATIONAL AND NATIONAL PRESENTATIONS

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Ip V, Toth Z, **McBride-Gagyi SH**. Calcified Cartilage Islands in Mouse Bones. *American Society of Bone and Mineral Research 2015 Annual Meeting*, Seattle, WA, October 9-12, 2015, poster presentation.

Toth Z, **McBride-Gagyi SH**. Brittleness of Osteoblast-derived BMP2 knockout bones is due to increased porosity and cellularity. *Orthopaedics Research Society 2015 Annual Meeting*, Las Vegas, NV, March 27-31, 2015, poster presentation.

**McBride SH**, McKenzie JA, Rosen V, Silva MJ. Osteoblast-derived But Not Vascular Endothelial-derived Bmp2 Is Necessary For Stress-fracture Healing. *Orthopaedics Research Society 2014 Annual Meeting*, New Orleans, LA, March 15-18, 2014, **oral presentation**.

**McBride SH**, McKenzie JA, Rosen V, Silva MJ. Osteogenic-derived BMP2, but not Vascular-derived BMP2, Affects Non-endochondral Stress Fracture Healing. *43<sup>rd</sup> International. Sun Valley Workshop: Musculoskeletal Biology*, Sun Valley, ID, August 4-7, 2013, **oral presentation & award winner**.

**McBride SH**, McKenzie JA, Anda K, Kuhlman P, Rosen V, Silva MJ. Contribution of vascular- and osteogenic-derived BMP2 to postnatal skeletal growth and woven bone formation. *59<sup>th</sup> Annual Meeting of the Orthopaedics Research Society*, San Antonio, TX, January 26-29, 2013, poster presentation.

**McBride SH**, Dolejs S, Knothe U, Knothe Tate ML. Mechano-Histology: Can Major and Minor Centroidal Axes Serve as Reference Points? *Biomedical Engineering Society Annual Meeting 2010*, Austin, TX, October 6-9, 2010, poster presentation.

**McBride SH**, Knothe U, Brianza S, Dolejs S, Knothe Tate ML. Periosteal Mechanics from the Macro to Nano Scales. *16<sup>th</sup> US National Conference for Theoretical and Applied Mechanics*, State College, PA, June 27-July 2, 2010, **oral presentation**.

Evans SF, **McBride SH**, Knothe Tate ML. Determining the mechanical properties of periosteum through hydration and shrinkage studies. *Biomedical Engineering Society Annual Meeting 2009*, Pittsburgh, PA, October 7-10, 2009, poster.

**McBride SH**, Knothe Tate ML. Elucidating the mechanical milieu of periosteal healing in a one stage bone transport system. *37<sup>th</sup> Annual Midwest Connective Tissue Conference*, Chicago, IL, May 8-9, 2009, poster and **short oral presentation**.

**McBride SH**, Knothe Tate ML. Shear stress upregulates condensed mesenchyme assembly in cell models. *16<sup>th</sup> Congress of the European Society of Biomechanics*, Lucerne, Switzerland, July 6-9, 2008, **oral presentation**.

**McBride SH**, Knothe Tate ML. Optimizing cell seeding to build tissues with epithelial-mesenchymal structure. *16<sup>th</sup> Congress of the European Society of Biomechanics*, Lucerne, Switzerland, July 6-9, 2008, poster presentation.

**McBride SH**, Knothe Tate ML. Cell seeding conditions exert a profound influence on the developmental context of embryonic mesenchymal stem cells for subsequent tissue generation. *54<sup>th</sup> Annual Meeting of the Orthopaedics Research Society*, San Francisco, CA, March 2-5, 2008, poster presentation.

**Unlisted:** Numerous university and regional presentations, including journal clubs, departmental seminars, university research fairs, and regional society meetings.

## AWARDED GRANTS

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AO Foundation Start-Up Grant	\$81,674	McBride-Gagyi (PI)	1/15/16-1/14/18
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“Masquelet Technique: Effects of implant material and surface topology on the mechanical properties and bone regeneration capabilities of the induced membrane.”  
Goal: To compare the effects of smooth and rough spacers made with polymethylmethacrate, the current standard, or titanium on membrane tensile strength and barrier properties as well as subsequent bone formation and strength.  
Role: PI

AO North America Resident Research Grant	\$9,250	Columbia (PI)	1/01/15-6/30/16
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“Does the timing of stem cell application augment bone repair in a rat model of distraction osteogenesis?”  
Goal: Compare the effects of local stem cell implantation either before, during, or after distraction on bone formation in a rat model of distraction osteogenesis.  
Role: Mentor

AO Trauma Kathy Cramer Career Development Award	\$15,000	Nicolaou (PI)	8/01/15-7/31/16
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“Masquelet Technique for Segmental Bone Repair: Effects of spacer material on membrane formation and bone regeneration”  
Goal: To compare the effects of spacers made with polymethylmethacrate, the current standard, titanium, or polyvinyl alcohol sponge on membrane formation, subsequent bone formation, and bone strength.  
Role: Mentor

Saint Louis University Presidential Research Fund	\$25,000	McBride-Gagyi (PI)	8/01/15-7/31/16
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“The effects of spacer material and topography on bone formation using the induced membrane technique.”  
Goal: To compare the effects of smooth and rough spacers made with polymethylmethacrate, the current standard, or titanium on membrane formation and subsequent bone formation.  
Role: PI

AO North America Resident Research Grant	\$9,250	Guevara (PI)	11/04/14-6/30/16
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“Does systemic application of mesenchymal stem cells accelerate or enhance bone regeneration in distraction osteogenesis?”  
Goal: Compare the effects of systemic stem cell implantation on bone formation and distraction rate in a rat model of distraction osteogenesis.  
Role: Mentor