

Exponent®
Engineering & Scientific Consulting

Sara Moshage, Ph.D.

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Professional Profile

Dr. Moshage specializes in the characterization of tissue biomechanics through a combination of imaging, experimental, and computational techniques. Her formal training in bioengineering and mechanical engineering includes quantitative image analysis, using clinical computed tomography (CT) and microCT, mechanical testing, motion capture of large animals, and creation of subject-specific finite element models from imaging data.

Dr. Moshage assesses medical device performance and regulatory compliance using ASTM and ISO standards and custom test setups. She performs MRI compatibility assessments of medical devices using computational and experimental methods. Additionally, she leads medical device wear testing evaluations for multiple total joint replacement types, including cervical and lumbar discs, as well as hips. Dr. Moshage also analyzes bone-implant interface strength using electromechanical and servohydraulic mechanical test systems.

Prior to joining Exponent, Dr. Moshage received her Ph.D. training in Mechanical Engineering from the University of Illinois Urbana-Champaign. While there, she studied the adaptation of juvenile equine bone in response to early age exercise interventions, with the goal of reducing fractures in adult racehorses. She developed the first empirical relationship between clinical CT density and compressive modulus for juvenile equine bone, which she then applied to determine subject-specific adaptations to exercise in a group of young horses. Additionally, she quantified the relationship between microstructure and mechanical properties in juvenile equine trabecular bone. This work required extensive machining of bone tissue samples, design of mechanical test fixtures, scanning in both clinical CT and microCT, and coding in MATLAB to automate all processing steps for image analysis and mechanical test data.

Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering, University of Illinois at Urbana-Champaign, 2023

M.S., Mechanical Engineering, University of Illinois at Urbana-Champaign, 2019

B.S., Bioengineering, University of Illinois at Urbana-Champaign, 2014

PhD-level Student Paper Competition Winner, ASME-BED/SB3C, 2022

Graduate Fellow, Beckman Institute for Advanced Science and Technology, 2020

Academic Appointments

Graduate Research Assistant, Tissue Biomechanics Lab, University of Illinois Urbana-Champaign, 2017 – 2023

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Graduate Teaching Assistant, Department of Mechanical Science and Engineering, University of Illinois Urbana-Champaign, 2017 – 2018

Prior Experience

Graduate Research Assistant, Tissue Biomechanics Lab, University of Illinois Urbana-Champaign, 2017 – 2023

Graduate Teaching Assistant, Department of Mechanical Science and Engineering, University of Illinois Urbana-Champaign, 2017 – 2018

Peace Corps Volunteer, Mozambique, September 2014 – November 2016

Professional Affiliations

American Society of Biomechanics (member)

Equine Science Society (member)

Order of the Engineer

Patents

US Patent 11,798,434: Three-Dimensional Knee Model with Realistic Physiological and Biomechanical Knee Function, October 2023 (Kersh ME, Goldsmith SW, Moshage SG, Pineda Guzman RA).

Publications

Moshage SG, McCoy AM, Kersh ME. Elastic modulus and its relation to apparent mineral density in juvenile equine bones of the lower limb. Journal of Biomechanical Engineering 2023, 145(8):1-13. Selected as Editors' Choice Paper.

Manandhar S, Song H, Moshage SG, Craggette J, Polk JD, Kersh ME. Spatial variation in young ovine cortical bone properties. Journal of Biomechanical Engineering 2023, 145(6):061002.

Yan C*, Moshage SG*, Kersh ME. Play during growth: the effect of sports on bone adaptation. Current Osteoporosis Reports 2020, 18:684–695. *authors contributed equally.

Ellerbrock R, Canisso I, Larsen R, Garrett K, Stewart M, Herzog K, Kersh ME, Moshage SG, Podico G, Lima F, Childs B. Fluoroquinolone exposure in utero did not affect articular cartilage of resulting foals. Equine Veterinary Journal 2020, 53: 385–396.

Moshage SG, McCoy AM, Polk JD, Kersh ME. Temporal and spatial changes in bone accrual, density, and strain energy density in growing foals. Journal of the Mechanical Behavior of Biomedical Materials 2020, Volume 103.

Conference Abstracts

Moshage SG, Petersen CA, Dillon AD, Brightbill EL, Delgorio PL, Torres WM, Holyoak DT, Siskey RL. From benchtop to in silico: Factors influencing radiofrequency-induced heating of bone. International Society for Magnetic Resonance in Medicine, 2025.

Petersen CA, Moshage SG, Dillon AD, Brightbill EL, Delgorio PL, Torres WM, Holyoak DT, Siskey RL.

High-fidelity modeling required for reliable RF heating assessments in bone. Orthopaedic Research Society, 2025.

Hammack SM, Moshage SG, Kersh ME, McCoy AM. Sex-specific myokine response to exercise in foals. Orthopaedic Research Society, 2025.

Opolz MD, Moshage SG, McCoy AM, Kersh ME. Predicting ground reaction forces from Froude number in growing foals. American Society of Biomechanics, 2024.

Hammack SM, Moshage SG, Kersh ME, McCoy AM. Serial measurements of systemic myokine levels in exercised foals: A pilot study. Orthopaedic Research Society, 2024.

Kersh ME, McCoy AM, Moshage SG. Determinants of juvenile trabecular bone quality. American Society for Bone and Mineral Research, 2023.

Mircoff SE, Teague AJ, Moshage SG, Sipes GC, McCoy AM, Kersh ME. Mechanical loading during normative ambulation does not contribute to periosteal formation in developing foals. Orthopaedic Research Society, 2023.

Teague AJ, Mircoff SE, Sipes GC, Moshage SG, McCoy AM, Kersh ME. Predicting macroscale bone growth with and without mechanical loading data. Orthopaedic Research Society, 2023.

GC Sipes, Moshage SG, Hammack S, McCoy AM, Kersh ME. Bone quality differences in fracture-prone regions of the equine third metacarpal. Orthopaedic Research Society, 2022.

Halloran KM, Moshage SG, Hammack SM, McCoy AM, Kersh ME. Compressive stresses and strain on the equine third metacarpal during growth. Summer Biomechanics, Bioengineering, and Biotransport Conference, 2020.

Pineda Guzman RA, Goldsmith S, Moshage S, Kersh ME. Replicating ligament multi-scale mechanical behavior using synthetic architected fibers. Orthopaedic Research Society, 2020.

Presentations

Moshage SG, Hammack SM, McCoy AM, Kersh ME. Full field analyses of equine bone reveal that adaptation to exercise may be sensitive to exercise mode. Poster presentation, Orthopaedic Research Society, Long Beach, CA, 2024.

Holyoak DT, Brightbill EL, Delgorio PL, Petersen CA, Moshage SG, Fox J, Siskey RL. RF heating methods for implants in bone: an ongoing challenge in MRI compatibility. Poster presentation, Orthopaedic Research Society, Long Beach, CA, 2024.

Moshage SG, McCoy AM, Kersh ME. Elastic strength and its relation to mineral density in juvenile equine bones of the lower limb. Podium presentation, Summer Biomechanics, Bioengineering, and Biotransport Conference, Cambridge, MD, 2022.

Moshage SG, Sipes GC, McCoy AM, Kersh ME. Development of a density-modulus relationship for juvenile equine bone. Poster presentation, Orthopaedic Research Society, Tampa, FL, 2022.

Moshage SG, Polk JD, Kersh ME. Ovine cortical bone responds to moderate exercise with increased density but not bone area fraction. Poster presentation, Summer Biomechanics, Bioengineering, and Biotransport Conference, Virtual, 2020.

Moshage SG, McCoy AM, Polk JD, Kersh ME. The effect of changes in mineral density and bone area fraction on strain energy density in growing foals. Podium presentation, 56th Annual Technical Meeting of the Society of Engineering Science, St. Louis, MO, 2019.

Moshage SG, McCoy AM, Polk JD, Kersh ME. Spatial heterogeneity in bone structure and composition during growth. Poster presentation, Bone and Muscle Interactions, Indianapolis, IN, 2019.

Moshage SG, McCoy AM, Vining R, Polk J, Kersh ME. Structural changes in equine proximal phalanx during growth. Podium presentation, Equine Science Society Symposium, Asheville, NC, 2019.

Moshage SG, Vining R, McCoy AM, Polk J, Kersh ME. Equine proximal phalanx bone properties during growth. Podium presentation, Pan-American Congress of Applied Mechanics, Ann Arbor, MI, 2019.

Moshage SG, Vining R, McCoy A, Polk J, Kersh ME. Changes in structure and loading conditions of the equine proximal phalanx during growth. Poster presentation, American Society of Biomechanics, Rochester, MN, 2018.

Moshage SG, Vining R, McCoy A, Polk J, Kersh ME. Changes in equine proximal phalanx morphology and density during growth. Poster presentation, World Congress of Biomechanics, Dublin, Ireland, 2018.