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Engineering & Scientific Consulting

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Professional Profile

Dr. Petersen specializes in the characterization of soft tissue mechanics through both experimental testing and finite element analysis (FEA). Her expertise lies in the field of orthopedics with experience developing surgical techniques for osteoarthritis, designing custom surgical tools, and characterizing soft tissue fatigue failure and wear mechanics. She is experienced in a vast range of mechanical testing methods such as friction testing, dynamic loading, fatigue testing, and compressive and tensile testing to characterize both linear and non-linear material behavior and failure, including that of viscoelastic tissue. Her expertise in FEA includes the modeling of complex biologic materials such as those exhibiting tension-compression nonlinearity, biphasic properties, or viscoelasticity. She also specializes in 3D modeling, design, and rapid prototyping.

Prior to joining Exponent, Dr. Petersen received her Ph.D. in Mechanical Engineering from Columbia University. Her research at Columbia focused on the development and analysis of bendable osteochondral allografts as a treatment for knee osteoarthritis. This work included extensive finite element analysis, cadaveric testing, and the designing, patenting, and manufacturing of a custom surgical tool for clinical trials. Furthermore, she investigated the wear mechanisms of articular cartilage and designed mechanical tests to examine tissue fatigue failure.

Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering, Columbia University, 2023

M.Phil., Mechanical Engineering, Columbia University, 2021

M.S., Mechanical Engineering, Columbia University, 2019

B.S., Mechanical Engineering, University of Washington, 2017

Prior Experience

Graduate Researcher and Teaching Assistant, Columbia University, September 2017 – May 2023

Research Assistant, Boechler Research Group, University of Washington, October 2016 – August 2017

Lab Assistant, Mechanical Test Lab, University of Washington, April 2017 – July 2017

Mechanical Engineering Intern, Leviton, June 2016 – September 2016

Research Assistant, Telerobotics Laboratory, University of Washington, June 2015 – September 2015

Professional Affiliations

Orthopaedic Research Society (ORS)

Patents

US Patent 2021/0298780 A1: Systems and Apparatuses for Manipulating Bendable Allografts, October 2019 (Ateshian GA, Zimmerman BK, Shaeffer CA, Rosenwasser MP).

Publications

Petersen, C.A., Sise, C.V., Dewing, J.X., Yun, J., Zimmerman, B.K., Guo, X.E., Hung, C.T., Ateshian, G.A. Immature bovine cartilage wear is due to fatigue failure from repetitive compressive forces and not reciprocating frictional forces. Osteoarthritis and Cartilage, 2023. doi.org/10.1016/j.joca.2023.08.008.

Ateshian, G.A., Kroupa, K.R., Petersen, C.A., Zimmerman, B.K., Maas, S.A., Weiss, J.W. Damage mechanics of biological tissues in relation to viscoelasticity. Journal of Biomechanical Engineering, 2023. 145(4):041011.

Ateshian, G.A., Petersen, C.A., Maas, S.A., Weiss, J.A. A numerical scheme for anisotropic reactive nonlinear viscoelasticity. Journal of Biomechanical Engineering, 2023. 145(1):011004.

Petersen, C.A., Spack, K.A., Cook, J.L., Hung, C.T., Rosenwasser, M.P., Ateshian, G.A. Bendable osteochondral allografts for patellar resurfacing: A finite element analysis of congruence. Journal of Biomechanics, 2022. 142:111240.

Gangi, L.R.*, Petersen, C.A.*, Oungoulian, S.R., Estell, E.G., Durney, K.M., Suh, J.T., Ateshian, G.A., Hung, C.T. A friction testing-bioreactor device for study of synovial joint biomechanics, mechanobiology, and physical regulation. Journal of Visualized Experiments (JoVE), 2022. e63880. (*contributed equally)

Chen, D., Wu, J.Y., Kennedy, K.M., Yeager, K., Bernhard, J.C., Ng, J.J., Zimmerman, B.K., Robinson, S., Durney, K.M., Shaeffer, C., Vila, O.F., Takawira, C., Gimble, J.M., Guo, X.E., Ateshian, G.A., Lopez, M.J., Eisig, S.B., and Vunjak-Novakovic, G. Tissue engineered autologous cartilage-bone grafts for temporomandibular joint regeneration. Science Translational Medicine, 2020. Vol. 12, Issue 565.

Durney, K.M., Shaeffer, C.A., Zimmerman, B.K., Nims, R.J., Oungoulian, S., Jones, B.K., Boorman-Padgett, J.F., Suh, J.T., Shah, R.P., Hung, C.T., and Ateshian, G.A. Immature bovine cartilage wear by fatigue failure and delamination. Journal of Biomechanics, 2020. 107:109852

Schwartz, J.J., Behrou, R., Cao, B., Bassford, M., Mendible, A., Shaeffer, C., Boydston, A.J., Boechler, N. Reduced strain mechanochemical activation onset in microstructured materials. Polymer Chemistry, 2020. Vol. 11, Issue 6.

Conference Abstracts:

Spack, K.A., Petersen, C.A., Shyu, P.T., Guo, X.E., Gardner, T.R., Cook, J.T., Hung, C.T., Rosenwasser, M.P., Ateshian, G.A. Bendable osteochondral allofrafts for patellar resurfacing: a cadaveric analysis of congruence. Orthopedic Research Society Annual Conference. Dallas, Texas. 2023.

Spack, K.A., Petersen, C.A., Shyu, P.T., Bozynksi, C.C., Romesburg, M.K., Guo, X.E., Cook, J.T., Hung, C.T., Rosenwasser, M.P., Ateshian, G.A. Maintaining chondrocyte viability in the machining of bendable osteochondral allografts. Orthopedic Research Society Annual Conference. Dallas, Texas. 2023.

Sise, C.V., Petersen, C.A., Carbone, B., Hung, C.T., Ateshian, G.A. Frictional forces do not cause wear in human articular cartilage. Summer Biomechanics, Bioengineering and Biotransport Conference. Cambridge, Maryland. 2022.

Spack, K.A., Petersen, C.A., Shyu, P.T., Guo, X.E., Cook, J.L., Hung, C.T., Ateshian, G.A. Maintaining high chondrocyte viability while machining live canine osteochondral patellar allografts. Northeast Bioengineering Conference. New York City, New York. 2022.

Spack, K.A., Shaeffer, C.A., Shyu, P.T., Cook, J.L., Hung, C.T., Rosenwasser, M.P., Ateshian, G.A. Altering surface curvature of patellar osteochondral allografts through subject-specific modification of subchondral bone. Summer Biomechanics, Bioengineering and Biotransport Conference. Virtual. 2021.

Murphy, L.A., Gangi, L.R., Shaeffer, C.A., Stefani, R.M., Jacobsen, T.D., Kenawy, H.M., Shah, R.P., Trofa, D.P., Chahine, N.O., Ateshian, G.A., Hung, C.T. Toward defining the role of the synovium in mitigating normal articular cartilage wear and tear. Summer Biomechanics, Bioengineering and Biotransport Conference. Virtual. 2020.

Presentations

Petersen, C.A., Sise, C.V., Dewing, J.X., Carbone, B., Yun, J., Hung, C.T., Ateshian, G.A. Articular cartilage wear is caused by cyclic compressive stresses and not by frictional sliding. Orthopedic Research Society Annual Conference. Dallas, Texas. 2023.

Petersen, C., Spack, K., Shyu, P., Guo, X.E., Hung, C., Rosenwasser, M., Ateshian, G. Bending and shifting osteochondral patellar allografts improve patellofemoral joint congruence. Northeast Bioengineering Conference. New York City, New York. 2022.

Shaeffer, C.A., Spack, K.A., Hung, C.T., Rosenwasser, M.P., and Ateshian, G.A. Adaptively conforming osteochondral patellar allografts for joint resurfacing: a finite element analysis of congruence. Summer Biomechanics, Bioengineering and Biotransport Conference. Virtual. 2020.