

Exponent® Engineering & Scientific Consulting

Genymphas Higgs, Ph.D.

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Professional Profile

Dr. Higgs' background spans biomedical engineering and epidemiology, with a focus on the real-world evaluation of medical device performance. He has extensive experience with characterizing clinically relevant changes to metallic, ceramic and polymeric biomaterials, and has expertise in corrosion assessments of orthopedic alloys.

Dr. Higgs' laboratory work has encompassed mechanical, electrochemical and structural investigations of medical devices, leveraging his proficiencies with mechanical testing, electrochemical impedance spectroscopy (EIS), Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM) and micro-CT analysis. His computational initiatives have included advanced statistical modeling to elucidate the clinical and design variables that influence the outcome of orthopedic implants. Dr. Higgs has also used his skillset to provide technical and regulatory guidance for novel medical devices, within context of the de novo and 510(k) pathways of the U.S. FDA. Additionally, he has supported the development of an operational roadmap applicable to international medical device suppliers seeking to navigate the impact of the European Union Medical Device Regulation (EU-MDR).

Prior to joining Exponent, Dr. Higgs was a graduate research fellow in the Implant Research Center at Drexel University, where his doctoral research focused on developing electrochemical methods to quantitatively evaluate the corrosion of femoral prostheses. He also completed a regulatory fellowship (FDA) through the Oak Ridge Institute for Science and Education. As a part of the FDA's Medical Device Epidemiology Network (MDEpiNet), he coordinated an institutional partnership that explored the potential of orthopedic implant retrieval analysis as a source of real-world data.

Academic Credentials & Professional Honors

Ph.D., Biomedical Engineering, Drexel University, 2020

M.S., Epidemiology, Drexel University, 2017

B.S., Biomedical Engineering, Drexel University, 2013

Young Investigator Scholarship, International Society for Technology in Arthroplasty, 2018

German Academic Exchange Service (DAAD) Fellowship, 2018

Oak Ridge Institute for Science and Education (ORISE) Fellowship, 2015-2017

James A. Rand Award, American Association of Hip and Knee Surgeons, for Most Outstanding Paper inArthroplasty Surgery, 2012

Publications

MacDonald DW, Higgs GB, Chen AF, Malkani AL, Mont MA, Kurtz SM. Oxidation, Damage Mechanisms, and Reasons for Revision of Sequentially Annealed Highly Crosslinked Polyethylene in Total Knee Arthroplasty. The Journal of arthroplasty. 2018 Apr 1;33(4):1235-41.

Higgs GB, MacDonald DW, Lowell J, Padayatil A, Mihalko WM, Siskey RL, Gilbert JL, Rimnac CM, Kurtz SM. Is Corrosion a Threat to the Strength of the Taper Connection in Femoral Components of Total Hip Replacements?. Corrosion. 2017 Oct 5;73(12):1538-43.

Urish KL, Hamlin BR, Plakseychuk AY, Levison TJ, Higgs GB, Kurtz SM, DiGioia AM. Trunnion failure of the recalled low friction ion treatment cobalt chromium alloy femoral head. The Journal of arthroplasty. 2017 Sep 1;32(9):2857-63.

Higgs GB, MacDonald DW, Gilbert JL, Rimnac CM, Kurtz SM, Chen AF, Klein GR, Hamlin BR, Lee GC, Mont MA, Cates HE. Does taper size have an effect on taper damage in retrieved metal-on-polyethylene total hip devices?. The Journal of arthroplasty. 2016 Sep 1;31(9):277-81.

Mihalko WM, Lowell J, Higgs GB, Kurtz S. Total knee post-cam design variations and their effects on kinematics and wear patterns. Orthopedics. 2016 May 26;39(3):S45-9.

Kurtz SM, Lanman TH, Higgs GB, MacDonald DW, Berven SH, Isaza JE, Phillips E, Steinbeck MJ. Retrieval analysis of PEEK rods for posterior fusion and motion preservation. European Spine Journal. 2013 Dec 1;22(12):2752-9.

Higgs GB, Hanzlik JA, MacDonald DW, Gilbert JL, Rimnac CM, Kurtz SM, Implant Research Center Writing Committee. Is increased modularity associated with increased fretting and corrosion damage in metal-on-metal total hip arthroplasty devices?: a retrieval study. The Journal of arthroplasty. 2013 Sep 1;28(8):2-6.

MacDonald DW, Higgs GB, Parvizi J, Klein G, Hartzband M, Levine H, Kraay M, Rimnac CM, Kurtz SM. Oxidative properties and surface damage mechanisms of remelted highly crosslinked polyethylenes in total knee arthroplasty. International orthopaedics. 2013 Apr 1;37(4):611-5.

Book Chapters

Arnholt C, Underwood R, MacDonald RW, Higgs GB, Chen AF, Klein G, Hamlin B, Lee GC, Mont M, Cates H, Malkani A, Kraay M, Rimnac C, Kurtz SM. Microgrooved surface topography does not influence fretting corrosion of tapers in total hip arthroplasty: Classification and retrieval analysis. In: Greenwald AS, Kurtz SM, Lemons J, Mihalko WM, editors. Modularity and Tapers in Total Joint Replacements, STP 1591. Conshohocken, PA: ASTM; 2015. p. 99-112

Higgs GB, Hanzlik JA, MacDonald DW, Kane WM, Day JS, Klein GR, Parviz iJ, Mont MA, Kraay MJ, Martell JM, Gilbert JL, Rimnac CM, Kurtz SM. Method of characterizing fretting and corrosion at the various taper connections of retrieved modular components from metal-on-metal total hip arthroplasty. In: Kurtz SM, Greenwald AS, Mihalko WM, Lemons J, editors. Metal-on-Metal Total Hip Replacement Devices, STP 1560. Conshohocken, PA: ASTM; 2013.

Presentations

Higgs GB, Lewis TD, Darville LL, Brown SR. Shelter from the Storm: Climatic Adaptations for the Future. Sustainable Grand Bahama Conference. University of the Bahamas, Grand Bahama, Bahamas. March 5-6, 2020.

Higgs GB, Lin J, Khullar P, Kurtz SM, Gilbert JL. A Quantitative Method to Assess Corrosion Severity. Talk 8, Workshop on Accelerated Aging Methods and Testing Techniques for Medical Devices. ASTM

International, Denver, CO, May 14, 2019.

Higgs GB, Sullivan M, Shenoy A, Kane W, Siskey RL, Gilbert JL, Kurtz SM. Nondestructive Identification of Subsurface Corrosion Features in Orthopedic Alloys Talk 7, Workshop on Accelerated Aging Methods and Testing Techniques for Medical Devices. ASTM International, Denver, CO, May 14, 2019.

Evans L, Higgs GB, Siskey RL. In Vitro Evaluation of Fretting Corrosion in a Modular Acetabular Taper. Poster No. 2220, 65th Annual Meeting of the Orthopaedic Research Society, Austin, TX, February 2-5, 2019.

Higgs GB, Siskey RL, Mihalko WM, Rimnac CM, Gilbert JL, Kurtz SM. Electrochemical Impedance Spectroscopy as a Method to Distinguish Corrosion Severity and Damage Modes in Retrieved Femoral Heads 25th Annual Congress of the International Society for Technology in Arthroplasty, London, UK, October 10-13, 2018.

Higgs GB, Gerveshi C, Evans A, Tabb L, Kurtz SM. Incorporating Retrieval Analysis into Database Research to Understand the Role of Periprosthetic Joint Infection on Taper Corrosion in Total Hip Replacements. Paper No. 123, 7th Annual International Congress of Arthroplasty Registries, Reykjavik, Iceland, June 9-11, 2018.

Higgs GB, MacDonald DW, Lowell J, Padayatil A, Mihalko WM, Siskey RL, Gilbert JL, Rimnac CM, Kurtz SM. Does Corrosion Loosen the Taper Connection of Femoral Components in Total Hip Replacements? Paper No. 0276, 64th Annual Meeting of the Orthopaedic Research Society, New Orleans, LA, March 10-13, 2018.

Higgs GB, Gerveshi C, Evans A, Tabb L, Kurtz SM. Can an Infection Cause Corrosion of a Hip Replacement? Bridging the Gap Between Epidemiology and Engineering. Poster No. 1807, 64th Annual Meeting of the Orthopaedic Research Society, New Orleans, LA, March 10-13, 2018.

Arnholt CM, White JB, Higgs GB, MacDonald DW, Lowell JA, Perkins MR, Mihalko WM, Kurtz SM. Associations Between Metallosis and Tissue Metal Concentration in Autopsy Retrieved TKA. Paper No. 207, 64th Annual Meeting of the Orthopaedic Research Society, New Orleans, LA, March 10-13, 2018.

Higgs GB, Gervishi C, Tabb L, Evans A, Kurtz SM. Bridging the Gap Between Implant Retrieval Research and Epidemiological Studies using Survival Analysis. Poster No. 6, 27th Annual Meeting of the American Association of Hip and Knee Surgeons, Dallas, TX, November 2-5, 2017.

Higgs GB, Macdonald DW, Paxton L, Marinac-Dabic M, Kurtz SM, Combining Retrieval Research with Epidemiology to Understand the Role of Periprosthetic Joint Infection on the Oxidative Degradation of Total Hip Replacements. Poster No. 2, 8th International UHMWPE Meeting, Torino, Italy, October 19, 2017.

Higgs GB, Macdonald DW, Padayatil A, Spece H, Siskey RL, Callander S, Kurtz SM. Method of Estimating Material Loss for Retrieved Femoral Stems with Gross Trunnion Failure. Symposium on Beyond the Implant Retrieval Analysis Methods for Implant Surveillance. ASTM International, Toronto, Canada, May 9, 2017.

Higgs GB, Siskey RL, Mejia L, Burke D, Mahr A, Kurtz SM. Mechano-Electrochemical Testing for Clinically Relevant Evaluation of Total Hip Arthroplasty Device Performance. 21st Congress of the European Society of Biomechanics. Lyon, France, July 10–16, 2016.

Higgs GB, MacDonald DW, Gilbert JL, Rimnac CM, Kurtz SM. Does Taper Size Have an Effect on Taper Damage in Retrieved Metal-on-Polyethylene Total Hip Devices? 25th Annual Meeting of the American Association of Hip and Knee Surgeons, Dallas, TX, November 5-8, 2015.

Higgs GB, Siskey RL, Gilbert JL, Mihalko WM, Rimnac CM, Kurtz SM. What Effect Does the Strength of

the Taper Connection Have on Taper Damage in Retrieved Total Hip Devices? 61st Annual Meeting of the Orthopaedic Research Society. Las Vegas, NV, March 28–31, 2015.

Higgs GB, MacDonald DW, Chen AF, Klein GR, Hamlin BR, Lee G-C, Mont MA, Cates HE, Malkani AL, Kraay MJ, Gilbert JL, Rimnac CR, Kurtz SM. Does Taper Size Have an Effect on Taper Damage in Retrieved Total Hip Devices? 61st Annual Meeting of the Orthopaedic Research Society. Las Vegas, NV, March 28–31, 2015.

Arnholt CM, Underwood RJ, MacDonald DW, Higgs GB, Chen A, Klein GR, Hamlin B, Lee GC, Mont MA, Cates H, Malkani A, Rimnac CM, Kurtz SM. Micro-grooved Surface Topography Does Not Influence Fretting Corrosion of Tapers in THA: Classification and Retrieval Analysis. Symposium on Modularity and Tapers in Total Joint Replacement Devices. ASTM International, New Orleans, LA, November 10, 2014.

Higgs GB, MacDonald DW, Mihalko WM, Siskey RL, Gilbert JL, Rimnac CM, Kurtz SM. A Pilot Study Characterizing Taper Interface Integrity and Its Relationship with Taper Damage in Retrieved Femoral Components of Total Hip Replacement Devices. Symposium on Modularity and Tapers in Total Joint Replacement Devices. ASTM International, New Orleans, LA, November 10, 2014.

Higgs GB, Hanzlik J, MacDonald D, Klein G, Parvizi J, Mont MA, Kraay M, Rimnac CM, Kurtz SM. Does Fretting and Corrosion Occur at Modular Interfaces other than the Head-Stem Junction in Metal-on-Metal Total Hip Arthroplasty Devices? Poster No. 1759, 59th Annual Meeting of the Orthopaedic Research Society, San Antonio, TX, January 26–29, 2013.

Underwood RJ, MacDonald D, Higgs GB, Day J, Siskey RL, Kurtz SM. Tribocorrosion in Taper Junctions: Measurements and Observations from Explanted MoM Hips. Poster No. 1763, 59th Annual Meeting of the Orthopaedic Research Society, San Antonio, TX, January 26–29, 2013.

Kurtz SM, MacDonald DW, Higgs GB, Gilbert JL, Parvizi J, Klein G, Mont MA, Marshall A, Kraay M, Stulberg B, Cates H, Malkani A, Rimnac CM. Are 36+ MM Diameter HXLPE Bearings at Risk of Increased Wear from Modular Taper Corrosion with Ceramic and CoCr Heads? Poster No. 1768, 59th Annual Meeting of the Orthopaedic Research Society, San Antonio, TX, January 26–29, 2013.

Underwood RJ, MacDonald D, Higgs GB, Day J, Siskey RL, Kurtz SM. Does Visual Inspection of the Taper Head / Stem Junctions in Metal-on-Metal Hips Accurately Characterize the Corrosion and Wear? Poster No. 1797, 59th Annual Meeting of the Orthopaedic Research Society, San Antonio, TX, January 26–29, 2013.

Higgs GB, Kurtz SM. Hanzlik JA, MacDonald DW, Klein G, Parvizi J, Mont M, Kraay M, Martell J, Gilbert J, Rimnac CM. Is increased modularity associated with increased wear debris in metal-on-metal total hip arthroplasty devices? James A. Rand Award, 22nd Annual Meeting of the American Association of Hip and Knee Surgeons, Dallas, TX, November 1-3, 2012.

Higgs GB, Kurtz SM. Hanzlik JA, MacDonald DW, Kane WM, Day JS, Klein G, Parvizi J, Mont M, Kraay M, Martell J, Gilbert J, Rimnac CM. Retrieval analysis of metal-on-metal total hip prostheses: Characterizing fretting and corrosion at modular interfaces. 25th Annual Congress of the International Society for Technology in Arthroplasty, Sydney, Australia, October 3-6, 2012.

Higgs GB, Kurtz SM, Berven S, Isaza J, Lanman T, MacDonald D, Jaekel D, Penmatsa M, Ho C, Steinbeck M. Characterization of in vivo change and histological response of retrieved PEEK rod systems for posterior lumbar stabilization and fusion. 9th World Biomaterials Congress, Chengdu, China, June 1– 5, 2012.

Ho CM, MacDonald D, Penmatsa MK, Higgs GB, Isaza J, Kurtz SM, Steinbeck M. Histological and retrieval analysis of PEEK spherical nucleus pulposus replacements, 9th World Biomaterials Congress, Chengdu, China, June 1–5, 2012.

MacDonald D, Higgs GB, Parvizi J, Klein G, Hartzband M, Lee GC, Levine H, Kraay M, Rimnac C, Kurtz S. Oxidative stability, reasons for revision, and damage mechanisms of remelted highly crosslinked polyethylenes in TKA. 9th World Biomaterials Congress, Chengdu, China, June 1–5, 2012.

Higgs GB, Hanzlik JA, MacDonald DW, Kane WM, Day JS, Klein G, Parvizi J, Mont M, Kurtz SM. Fretting and corrosion at the taper connections of retrieved modular components from metal-on-metal total hip arthroplasty. Talk 13, Symposium on Metal-on-Metal Total Hip Replacement Devices, Phoenix, AZ, May 8, 2012.

MacDonald D, Higgs GB, Parvizi J, Klein G, Hartzband M, Levine H, Kraay MJ, Rimnac C, Kurtz SM. Surface damage and oxidative properties of remelted highly crosslinked polyethylenes in total knee arthroplasty. Poster No. 143, 79th Annual Meeting of the American Academy of Orthopaedic Surgeons, San Francisco, CA, February 7–11, 2012.

Higgs GB, MacDonald, DM, Jaekel DJ, Penmatsa MK, Ho CM, Lanman TH, Berven SH, Isaza JE, Steinbeck MJ, Kurtz SM. Retrieval Analysis of PEEK Rods for Posterior Lumbar Stabilization and Fusion. Poster No. 1117, 58th Annual Meeting of the Orthopaedic Research Society, San Francisco, CA, February 4–7, 2012.

Ho CM, Penmatsa MK, MacDonald DW, Higgs GB, Isaza J, Kurtz SM, Steinbeck MJ. Histology of Periprosthetic Tissues and Analysis of Retrieved PEEK Spherical Nucleus Pulposus Replacements. Poster No. 1118, 58th Annual Meeting of the Orthopaedic Research Society, San Francisco, CA, February 4–7, 2012.

MacDonald DW, Higgs GB, Parvizi J, Klein G, Hartzband M, Levine H, Kraay M, Rimnac C, Kurtz SM. Material and Clinical Performance of Remelted Highly Crosslinked Polyethylene Used in Total Knee Arthroplasty. Poster No. 1999, 58th Annual Meeting of the Orthopaedic Research Society, San Francisco, CA, February 4–7, 2012.

MacDonald D, Higgs GB, Parvizi J, Klein G, Hartzband M, Levine H, Kraay MJ, Rimnac C, Kurtz SM. Oxidative properties of remelted highly crosslinked polyethylenes in total knee arthroplasty. Paper No. 34, 21st Annual Meeting of the American Association of Hip and Knee Surgeons, Dallas, TX, November 4-6, 2011.

MacDonald D, Hanzlik J, Day J, Heffernan J, Higgs GB, Klein G, Kraay K, Rimnac CM, Parvizi J, Kurtz SM. Bone ongrowth in retrieved porous tantalum monoblock tibial plates. Poster 1036, 57th Annual Meeting of the Orthopaedic Research Society, Vol. 36, Long Beach, CA, January 13–16, 2011.