BIOGRAPHICAL SKETCH
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NAME: Stuart B. Goodman M.D. Ph.D.

eRA COMMONS USERNAME: GOODMAN.STUART

POSITION TITLE: Robert L and Mary Ellenburg Professor of Surgery, and Professor of Orthopaedic Surgery

EDUCATION/TRAINING:

INSTITUTION AND LOCATION	DEGREE	Completion Date	FIELD OF STUDY
University of Toronto, Canada	B.Sc.	1974	Sciences
University of Toronto, Canada	M.D.	1978	Doctor of Medicine
University of Toronto, Canada		1978-1984	Internship and Orthopaedic Residency
University of Toronto, Canada	M.Sc.	1982	Institute of Medical Science
University of Toronto, Canada		1984-1985	Clinical and Research Fellowship
University of Toronto, Canada	FRCSC	1984	Fellow Royal College of Surgeons of Canada
Lund University	Ph.D.	1994	Orthopaedic Surgery
University of Toronto – Mount Sinai Hospital		2001-2	Visiting Professor

A. Personal Statement

As an academic orthopaedic surgeon-scientist who specializes in adult reconstruction (hip and knee replacement) and revision joint replacement for 30 years, dealing with biomaterials, bone and cartilage loss clinically is a daily occurrence. Whether bone loss is due to trauma, periprosthetic osteolysis, infection, arthritis or other causes, understanding the relevant and fundamental inflammatory processes associated with implants and bone loss, and restoring lost bone by tissue engineering methods are main concentration areas of our laboratory. Our interdisciplinary group composed of orthopaedic surgeons and researchers, bioengineers, cell and molecular biologists, radiologists and researchers specializing in advanced imaging techniques, pathologists, biostatisticians and others have the necessary experience and resources to pursue our research goals in a broad based, collaborative manner. As an NIH funded PI, I have guided this group in exploring pertinent scientific questions that have direct translation to patient care.

1. Nabeshima A, Pajarinen J, Lin TH, Jiang X, Gibon E, Cordova LA, Loi F, Lu L, Jamsen E, Egashira K, Yang F, Yao Z, Goodman SB. Mutant CCL2 protein coating mitigates wear particle-induced bone loss in a murine continuous polyethylene infusion model, Biomaterials 2017 Feb;117:1-9.

2 Lin T-H, Gibon E, Loi F, Pajarinen J, Córdova LA, Nabeshima A, Lu L, Yao Z, Goodman SB: Decreased osteogenesis in mesenchymal stem cells derived from the aged mouse is associated with enhanced NF-κB activity. J Orthop Res. 2017;35(2):281-288.

3. Pajarinen J, Nabeshima A, Lin TH, Sato T, Gibon E, Jämsen E, Lu L, Nathan K, Yao Z, Goodman SB: Murine model of progressive orthopaedic wear particle induced chronic inflammation and osteolysis. Tissue Eng Part C Methods. 2017 Dec;23(12):1003-1011. PMID: 28978284.

B. Positions and Honors

Positions and Employment

1985 – Assistant Professor, Stanford University; Attending Orthopaedic Surgeon - Stanford University Medical Center, and Consulting Orthopaedic Surgeon Palo Alto Veteran's Hospital and Children's Hospital at Stanford.

1990+ Associated Faculty - Biomechanical Engineering; 2000+ Bioengineering, Stanford University

1992–	Associate Professor with Tenure - Division of Orthopaedic Surgery, Stanford University
2/1994–2002	Chief, Division of Orthopaedic Surgery, Stanford University. Director of Orthopaedic Residency Program (until 2000), Chief of Orthopaedic Outpatient Clinic, Co-Director of Surgical Arthritis Unit
6/1998–present	Professor- Department of Orthopaedic Surgery, Stanford University
2006+	Robert L. and Mary Ellenburg Professor of Surgery, Stanford University
2012+	Professor of Bioengineering (by courtesy), Stanford University
2014+	Fellow, Institute of Chemistry, Engineering and Medicine for Human Health (ChEM-H), Stanford University

Other Experience and Professional Memberships

1995, 2000, 2007	Co-Chairman- AAOS and NIH workshop- Implant Wear and Total Joint Replacement
1998-2004	Member of the Biomedical Engineering Committee of AAOS
2000-2004	Board of Directors Society for Biomaterials
2001-2002	President- Society for Biomaterials
2002-2004	Board of Directors Orthopaedic Research Society
2005+	Biological Implants Committee-AAOS (Chairman 2011-16)
2005-2009	FDA panel member-Orthopaedic and Rehabilitation Devices Panel, currently a consultant.
2008-2011	Member – NIH Musculoskeletal Tissue Engineering Panel (Vice-Chairman 2009-2011)
2010+	Deputy Editor - Clinical Orthopaedics and Related Research (Liaison for Hip Society)
2011	Fellow – Japanese Society of the Promotion of Science
2012	Fellow – American Institute of Medical and Biological Engineers
2014+	Associate Editor – Biomaterials; Associate Editor- J Orthopaedic Research.
2016	Fellow - International Combined Orthopaedic Research Societies

Editorial Board Member- J Orthop Res, Bone & Joint Res, J Biomed Mater Res A and B, Biomaterials, J Arthroplasty, Clinical Orthop Rel Res, Orthopedics, J Orthopaedic Translation. Member of numerous hospitals, regional, national and international committees and organizations in orthopaedics and biomaterials. Grant reviewer– agencies worldwide; over 80 visiting professorships, major invited lectures, keynote addresses.
Fellow: Royal College Surgeons of Canada, American Board of Orthopaedic Surgery, American Academy of Orthopaedic Surgeons, American College of Surgeons

Awards and Honors: Awards for research from:

1983-1984	Canadian Residents Association
1994	American Orthopaedic Association
1986-1988	Orthopaedic Research and Education Foundation
1995-1996	Western Orthopaedic Association
1997-1998	Orthopaedic Research Society
1997, 2001	Society for Biomaterials
2000	Clemson Award for Basic Research-Society for Biomaterials
2003, 2006	Stanford University Medical Student Research Symposium - Mentor
2005	American Society for Biomechanics, Clinical Biomechanics Award
2006, 2008-2009	USA Medical Student Research forums – Award as Mentor
2010	2010 Lalor Foundation Merit Award, Society for the Study of Reproduction
2015	American Academy of Orthopaedic Surgeons Achievement Award

For years named as: America's- Top Doctors, Top Surgeons, Top Orthopedists, Most Honored Professionals

C. Contributions to Science

The majority of Dr. Goodman's 500+ peer reviewed publications can be found at:
http://www.ncbi.nlm.nih.gov/sites/myncbi/stuart.goodman.1/bibliography/41157770/public/?sort=date&direction=ascending

1. Biomaterial Associated Inflammation: Total joint replacement of the hip and knee are amongst the most successful, long lasting, cost-effective procedures in surgery. However, some joint replacements initially fail to integrate with the surrounding musculoskeletal tissues, or loosen over time, and may be associated with severe bone destruction (periprosthetic osteolysis) that necessitate complex revision operations. Over the last 30 years, our group and collaborators worldwide were amongst the first to identify the complex cellular and molecular processes associated with successful and failed joint arthroplasties using diverse methods including analysis of

retrieved human tissue specimens, and relevant in vitro and in vivo animal models developed in our laboratory. We have identified complex interactions amongst cells of the innate and adaptive immune systems and cells of the mesenchymal-osteoblast lineage, which have broad implications for acute and chronic inflammatory processes in other organ systems throughout the body. Currently, our group is performing NIH sponsored research studies to mitigate acute and chronic inflammation by modulating the crosstalk between cells of the innate immune system and MSCs. In addition to modulating systemic macrophage trafficking, polarizing macrophages from a pro-inflammatory M1 to an anti-inflammatory tissue reconstructive M2 phenotype, and interfering with the downstream transcription of pro-inflammatory cytokines, chemokines and other factors using NF-kB decoy oligodeoxynucleotide, we have developed MSC preconditioning strategies and genetically modified MSCs that respond to local environmental cues. It is hoped that these strategies will be directly translatable to the clinical scenario. to extend the longevity of joint replacements in humans.

1.1. Lin TH, Pajarinen J, Nabeshima A, Lu L, Nathan K, Yao Z, Goodman SB: Establishment of NF-kB sensing and IL-4 secreting mesenchymal stromal cells as an “on-demand” drug delivery system to modulate inflammation. Cytotherapy. 2017;19(9):1025-1034. PMID: 28739167

1.2 Lin T, Kohno Y, Huang J-F, Romero-Lopez M, Pajarinen J, Maruyama M, Nathan K, Yao Z, Goodman SB. NFkB sensing IL-4 secreting mesenchymal stem cells mitigate the proinflammatory response of macrophages exposed to polyethylene wear particles. J Biomed Mater Res A. 2018;106(10):2744-2752. PMID: 30084534.

1.3. Nathan K, Lu LY, Lin T, Pajarinen J, Jämsen E, Juang J-F, Romero-Lopez M, Muruyama M, Kohno Y, Yao Z, Goodman SB. Precise immunomodulation of the M1 to M2 macrophage transition enhances MSC osteogenesis and differs by sex. Bone Joint Res 2019; 8:481–488. PMID: 31728188.

1.4. Lin T, Pajarinen J, Kohno Y, Huang J-F, Maruyama M, Romero-Lopez M, Nathan K, Yao Z, Goodman SB. Trained murine mesenchymal stem cells have anti-inflammatory effect on macrophages but defective regulation on T cell proliferation. FASEB J. 2019 Mar;33(3):4203-4211. PMID: 30521384.

2. Bone Regeneration: Bone loss can be due to different causes including trauma, infection, arthritis, osteoporosis, wear particle associated periprosthetic osteolysis, tumor etc. Understanding the biological mechanisms governing bone loss and repair using in vitro and in vivo studies can help identify novel treatments that are safe, effective and potentially translatable to humans. This subject is particularly germane to complex revision joint replacements, and fracture nonunions, where reconstitution of lost bone is particularly challenging. Our group, in collaboration with other laboratories worldwide has identified the importance of different chemokines in bone repair and developed reproducible murine models to examine stem cell trafficking and bone regeneration, as well as examining crosstalk between inflammatory cells and MSC lineage cells.

2.1. Zwingenberger S, Niederlohmann E, Vater C, Rammelt S, Matthys R, Bernhardt R, Valladares RD, Goodman SB, Stiehler M: Establishment of a femoral critical size bone defect model in immunodeficient mice. J Surg Res. 2013;181(1): e7-e14. PMID: 22765996.

2.2. Loi F, Córdova LA, Zhang R, Pajarinen J, Lin TH, Goodman SB, Yao Z. The effects of immunomodulation by macrophage subsets on osteogenesis in vitro. Stem Cell Res Ther. 2016;22;7(1):15. PMID: 26801095.

2.3 Goodman SB, Pajaren J, Yao Z, Lin T-H. Inflammation and bone repair: From particle disease to tissue regeneration. Front Bioeng Biotechnol. 2019 Sep 19; 7:230. PMID: 31608274.

2.4 Lin T, Kohno Y, Huang J-F, Romero-Lopez M, Maruyama M, Ueno M, Pajarinen J, Nathan K, Yao Z, Yang F, Wu JY, Goodman SB. Preconditioned or IL4-secreting mesenchymal stem cells enhanced osteogenesis at different stages. Tissue Eng Part A. 2019 Aug;25(15-16):1096-1103.PMID: 30652628.

3. Osteonecrosis**:** As an orthopaedic surgeon specializing in adult reconstruction, the treatment of osteonecrosis of the hip and knee is particularly challenging. Joint preserving procedures are preferred, however joint replacement, when indicated, can provide a vastly improved quality of life. We have described a novel method of joint preservation using harvested autologous osteoprogenitor cells for secondary osteonecrosis of the knee. Ongoing animal and clinical studies are validating new techniques for joint preservation using stem/osteoprogenitor cells combined with robust biomaterials to provide both mechanical support and biological stimuli for bone healing.

3.1. Goodman SB, Hwang K: Treatment of secondary osteonecrosis of the knee with local debridement and osteoprogenitor cell grafting. J Arthroplasty. 2015 Nov;30(11):1892-6.

3.2. Kawai T, Shanjani1 Y, Fazeli S, Behn AW, OkuzucY, Goodman SB, Yang YP: Customized, degradable, functionally graded scaffold for potential treatment of early stage osteonecrosis of the femoral head. J Orthop Res. 2018;36(3):1002-1011. PMID:28782831.

3.3. Goodman SB. The biological basis for concentrated iliac crest aspirate to enhance core decompression in the treatment of osteonecrosis. Int Orthop. 2018 Jul;42(7):1705-1709. PMID: 29435623
3.4 Maruyama M, Nabeshima A, Pan C-C, Behn A, Thio T, Lin T, Pajarinen J, Kawai T, Takagi M, Goodman SB, Yang YP: The effects of a functionally graded scaffold and bone marrow-derived mononuclear cells on steroid-induced femoral head osteonecrosis. Biomaterials. 2018 Dec; 187:39-46. PMID: 30292940.

D. Research Support
Current Research Support

1R01AR07314501 NIH/NIAMS 05/09/2018 - 05/08/2022
Customized MSCs to Enhance Healing of Bone Defects
This grant application examines the use of a novel microribbon scaffold, in addition to preconditioned or genetically modified MSCs, to improve the healing of a murine critical sized femoral bone defect.
Role: Principal Investigator

2R01AR06371706 NIH/NIAMS 08/01/2017 - 07/31/2022
Enhanced Bone Healing Around Implants by Transplanted NF-kB Driven Immunomodulating MSCs
This grant examines the use of preconditioned and genetically modified MSCs in a murine model of acute and chronic inflammation and osteolysis in younger and older, male and female mice.
Role: Principal Investigator

1R01AR072613 NIH/NIAMS (Yang, Goodman) 07/05/2018 - 04/30/2023
Tissue Engineering Approaches for Improved Treatment of Early Stage Osteonecrosis of the Hip
This grant explores a novel strategy to preserve the hip joint in animals with early stage steroid induced osteonecrosis of the femoral head
Role: Co-Principal Investigator

5UG3TR002136 (Tuan) 08/01/2017 - 07/31/2019
Univ of Pittsburgh/NIH/NCATS
Tissue Chip Modeling of Synovial Joint Pathologies: Effects of Inflammation and Adipose Mediated Diabetic Complications
We propose to develop a human micro Joint Chip (mJoint) from human primary cells or stem cells that contains interconnected engineered principal tissue elements of the joint to stimulate the synovial joint *in vivo*.
Role: Principal Investigator of Subaward

1UG3TR003090 (Gold) 09/26/2019 to 07/31/2021
Univ of Pittsburgh/NIH/NCATS
Joint Pain on a Chip: Mechanistic Analysis, Therapeutic Targets, and an Empirical Strategy for Personalized Pain Management. Our human micro Joint Chip (mJoint) using human primary cells or induced pluripotential cells will be expanded to include cells of the neural system in order to study the principles of pain in synovial joints.
Role: Principal Investigator of Subaward

1R34AR073505 NIH/NIAMS (Jones, Goodman, Mont) 01/07/2019 – 12/31/2020
Cell-Based Autogenous Grafting for the Treatment of Femoral Head Osteonecrosis
This is a planning grant for a multicenter study to examine the efficacy of core decompression with harvested concentrated iliac crest mononuclear cells, compared to core decompression alone for early stage (ARCO 1 and 2) osteonecrosis of the femoral head.
Role: Co-Principal Investigator

Coulter Foundation (Fan Yang, Constance Chu, Stuart Goodman) 5/16/2019 – 5/15/2020
Injectable Macroporous Scaffolds for Cartilage Repair'
Role: Co-Principal Investigator

Completed Research Support

3R01AR05565007 and S1 Goodman, Stuart B (PI) 08/01/2012 - 05/31/2017
National Institutes of Health
Biological Strategies to Mitigate the Adverse Effects of Polymeric Wear Particles
This grant studied the biomechanical properties of retrieved specimens from an animal model to mitigate peri-prosthetic osteolysis.

R01AR063717-01 Goodman, Stuart B (PI) 09/15/2012-07/31/2017
NIH/NIAMS - Wear Particle Disease and NF-kappa B Signaling. This grant studies the utility of NF-kappa B ODN in mitigating wear particle associated osteolysis in a murine model.

The Musculoskeletal Transplant Foundation Daldrup-Link, Heike E (PI) 02/01/2014 - 07/31/2017
Imaging Immune Responses to Stem Cell mediated Bone Repair
This project studies novel, non-invasive molecular imaging of immune responses to stem cell transplants to predict stem cell engraftment outcomes.
Role: Co-Investigator

2-R01-AR054458 Daldrup-Link, Heike E (PI) 07/01/2014 - 07/31/2017
National Institutes of Health
Creating Novel Imaging Tools to Diagnose Stem Cell Engraftment In Vivo
Major Goal: The major goal of this project is to develop a novel, non-invasive molecular imaging test for the detection of immune responses to stem cell transplants and to evaluate if this imaging test can be used to predict stem cell engraftment outcomes.
Role: Co-Investigator

Stanford Institute for Chemical Biology Yang, Fan (PI) 08-01-2014 – 07/31/2017
Stanford ChEM-H
Engineering Dual-Gradient Hydrogels for Elucidating Cell-Niche Interactions
Major Goals: The goal of this project is to develop biomimetic hydrogels with dual gradients of mechanical and biochemical cues to elucidate the effects of interactive niche signaling on stem cell fates.
Role: Co-Investigator

Coulter Foundation: Co-PIs: Dr Yunzi Peter Yang and Dr Stuart Goodman 05/01/2016 - 04/30/2017
Customized load-bearing and bioactive functionally graded scaffold for improved treatment of early stage osteonecrosis of the hip
Role: Co-Principal Investigator

5R01EB002524 (Gold) 09/20/2003 – 01/31/2019
NIH/NIBIB
Osteoarthritis: Quantitative Evaluation of Whole Joint Disease with MRI
Major Goals: To develop advanced methods to diagnose QA and other diseases using MRI.
Role: Co-Investigator

1R01DE024772 (Yang) 01/01/2015-12/31/2019
NIH/NIDCR
Microribbon-based scaffolds for bone repair
This grant aims to validate the efficacy of microribbon-based scaffolds as a novel type of cell carrier for enhancing stem cell survival and mineralized bone matrix deposition in vivo.
Role: Co-Investigator

3R01EB00252413 NIH/NIBIB (Gold G.) 09/20/2003 - 01/31/2020
Quantitative Evaluation of Whole Joint Disease with MRI
Role: Co-Investigator