BIOGRAPHICAL SKETCH

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NAME: Goodman, Stuart Barry

eRA COMMONS USER NAME: Goodman.Stuart

POSITION TITLE: Professor of Orthopaedic Surgery and Bioengineering, RL and M Ellenburg Chair in Surgery

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Toronto, Canada	B.Sc.	05/1974	Sciences
University of Toronto, Canada	M.D.	06/1978	Doctor of Medicine
University of Toronto, Canada		06/1984	Internship and Orthopaedic Residency
University of Toronto, Canada	M.Sc.	02/1982	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

A. Personal Statement

As an academic orthopaedic surgeon-scientist who specializes in complex lower extremity adult reconstruction and revision joint replacement for over 35 years, dealing with arthritic and traumatic conditions of bones and joints, inflammatory disorders, and biomaterials clinically is a daily occurrence. Whether tissue loss is due to trauma, byproducts from implants, infection, arthritis, osteonecrosis, or other causes, understanding the relevant and fundamental inflammatory processes associated with implants and bone and cartilage loss, and restoring deficient skeletal tissues by regenerative methods are main concentration areas of our laboratory. Our multidisciplinary laboratory group composed of orthopaedic surgeons and researchers, bioengineers, cell and molecular biologists, radiologists/researchers specializing in advanced imaging techniques, pathologists, veterinarians, biostatisticians, and others have extensive and unique experience and resources to pursue our research goals in a broad based, collaborative manner. As an NIH funded PI, I have helped lead and guide this group in exploring pertinent scientific questions that have direct application and translational relevance to patient care. I have strived to be a devoted and capable clinician-scientist, a role model for colleagues in the clinical and scientific fields, a reliable and stimulating educator and administrator, and a steward of the orthopaedic, biomaterials and tissue engineering research community. My recent studies in the field of osteoimmunology have shed light on how immune cells and signaling pathways influence bone repair, particularly in the context of aging and age-related bone disorders. The current grant application encompasses an outstanding multidisciplinary team with whom I have had long-term collaborations. Our common goal has been to elucidate the biological processes of debilitating, yet unresolved clinical diseases of bones and joints in patients, especially the elderly, and discover evidence-based treatments to decrease pain and provide earlier sustainable functional recovery.

Ongoing and recently completed projects that I would like to highlight include:

R01AR073145 NIH/NIAMS 05/09/2018 - 08/28/2022
Goodman (PI)
Customized MSCs to Enhance Healing of Bone Defects
R01AR063717 NIH/NIAMS 08/01/2017 - 01/31/2022
Goodman (PI)
Enhanced Bone Healing Around Implants by Transplanted NF-kB Driven Immunomodulating MSCs
R01AR072613 NIH/NIAMS 07/05/2018 - 04/30/2023
Yunzhi Peter Yang and Goodman, Role: Co-Principal Investigators
Tissue Engineering Approaches for Improved Treatment of Early-Stage Osteonecrosis of the Hip
5UG3TR002136 NIH/NCATS/NIAMS 08/01/2019 - 07/31/2022
Tuan/Lin (PI), Role: Subaward PI Goodman, Stuart
Tissue Chip Modeling of Synovial Joint Pathologies: Effects of Inflammation and Adipose Mediated Diabetic Complications
1GH3TR003090 NIH/NCATS/NIAMS 09/26/2019 to 07/31/2024 – 1 year no cost extension
Gold (PI), Role: Subaward PI Goodman, Stuart
Joint Pain on a Chip: Mechanistic Analysis, Therapeutic Targets, and an Empirical Strategy for Personalized Pain Management.
R01EB002524 NIH/NIBIB 3/1/2021-2/28/2025
Gold (PI), Role: Co-Investigator
Osteoarthritis: Quantitative Evaluation of Whole Joint Disease with MRI
R35GM137906 NIH/NIGMS 9/1/2020-8/30/2025
Tawfik (PI), Role: Co-Investigator
Myeloid Lineage Targeting to Improve Recovery from Injury and Surgery: Cellular and Molecular Mechanisms
R01 DE024772 NIH 09/2021 – 05/2026
Yang F (PI), Role: Co-Investigator
Microribbon Scaffold-Mediated Immunomodulation for Cranial Bone Repair
U01AR080993 NIH/NIAMS 08/10/2023 – 07/31/2028
Jones, Goodman, Mont (Multiple PIs) - Role: Co-Principal Investigators
Cell-Based Autogenous Grafting for the Treatment of Femoral Head Osteonecrosis
R01AR084472 NIH/NIAMS 08/15/2024 to 07/31/2029
Name of PD/PI: Lin, Hang; subaward PI: Goodman, Stuart
Repurposing FDA-approved Drugs for the Treatment of Osteoarthritis using High-Throughput Screening in Microphysiological Models
1R01AR082386 NIH/NIAMS 05/15/2024 to 04/30/2029
Name of PD/PI: Lin, Hang; subaward PI: Goodman, Stuart
Tissue Chip Modeling of Synovial Joint Pathologies: Effects of Inflammation and Adipose-Mediated Diabetic Complications

Citations:

1.1. Ueno M, Lo C-W, Barati D, Conrad B, Lin T, Kohno Y, Utsunomiya T, Zhang N, Maruyama M, Rhee C, Huang E, Romero-Lopez M, Tong X, Yao Z, Zwinenberger S, Yang F, Goodman SB. IL-4 overexpressing mesenchymal stem cells within gelatin-based microribbon hydrogels enhance bone healing in a murine long bone critical-size defect model. J Biomed Mater Res A. 2020 Nov 1;108(11):2240-2250. PMID: 32363683.
1.2. Ueno M, Zhang N, Hirata H, Barati D, Utsunomiya T, Shen H, Lin T, Maruyama M, Huang E, Yao Y, Wu J, Zwingenberger S, Yang F, Goodman SB. Sex differences in mesenchymal stem cell therapy with gelatin-based microribbon hydrogels in a murine long bone critical-size defect model. Front Bioeng Biotechnol. 2021 Oct 19;9:755964. PMID: 34738008.
1.3. Hirata H, Zhang N, Ueno M, Barati D, Kushioka J, Shen H, Tsubosaka M, Toya M, Lin T, Huang E, Yao Z, Wu JY, Zwingenberger S, Yang F, Goodman SB. Ageing attenuates bone healing by mesenchymal stem cells in a microribbon hydrogel with a murine long bone critical-size defect model. Immun Ageing. 2022 Mar 12;19(1):14. PMID: 35279175.
1.4. Huang EE, Zhang N, Ganio EA, Shen H, Li X, Ueno M, Utsunomiya T, Maruyama M, Gao Q, Su N, Yao Z, Yang F, Gaudillière B, Goodman SB. Differential dynamics of bone graft transplantation and mesenchymal stem cell therapy during bone defect healing in a murine critical size defect. J Orthop Translat. 2022; 4;36:64-74. PMID: 35979174.

B. Positions, Scientific Appointments, and Honors

2014- present - Fellow, Institute of Chemistry, Engineering and Medicine for Human Health (ChEM-H) Stanford University
2012 - present - Professor of Bioengineering (by courtesy), Stanford University
2006 - present - Robert L. and Mary Ellenburg Professor of Surgery, Stanford University
6/1998 - present - Professor- Department of Orthopaedic Surgery, Stanford University
2/1994–2002 Chief, Division of Orthopaedic Surgery, Director of Orthopaedic Residency Program, Chief of Orthopaedic Outpatient Clinic, Co-Director of Surgical Arthritis Unit, Stanford University
1992 Associate Professor with Tenure - Division of Orthopaedic Surgery, Stanford University
1990 Associated Faculty - Biomechanical Engineering; 2000+ Bioengineering, Stanford University
1985 Assistant Professor and Attending Orthopaedic Surgeon - Stanford University; Consulting Orthopaedic Surgeon Palo Alto VA Hospital and Children's Hospital at Stanford.

Medical Licensure

1989 Fellow - American Academy of Orthopaedic Surgeons, Re-certification–Jan 1998, July 2006, July 2016
1988 Fellow - American College of Surgeons
1987 Diplomat of The American Board of Orthopaedic Surgery
1985 Licentiate - State of California
1984 Royal College of Physicians & Surgeons (Canada), Specialized Certification in Orthopaedic Surgery
1982 Licentiate - State of Michigan, USA.
1979 Licentiate - Medical Council of Canada

Scientific Appointments and Professional Memberships

Memberships: Hip Society (American, European and International), Knee Society, American Association of Hip and Knee Surgeons, European Federation of National Associations of Orthopaedics and Traumatology (EFORT), Association Research Circulation Osseous (President 2024-6), Orthopaedic Research Society, Society For Biomaterials, American Society for Bone and Mineral Research, TERMIS.
Editorial Board Member- Bone & Joint Res, J Biomed Mater Res A and B, Biomaterials, J Arthroplasty, Clin Orthop Rel Res, J Orthop Translation, Regen. Eng. and Transl. Med., Bioengineering, Orthopedics.
Member of numerous hospitals, regional, national, and international committees and organizations in orthopaedics and biomaterials. Grant reviewer– agencies worldwide.
Over 120 visiting professorships, major invited lectures, keynote addresses.

2021-2024 Council Member NIH NIAMS
2020 Fellow - Orthopaedic Research Society (USA)
2016 Fellow - International Combined Orthopaedic Research
2012 Fellow - American Institute of Medical and Biological Engineers
2011 Fellow – Japanese Society of the Promotion of Science
2008-2011 Member – NIH Musculoskeletal Tissue Engineering Panel (Vice-Chairman 2009-2011)
2005-present Consultant - FDA -Orthopaedic and Rehabilitation Devices Panel
2005-2016 Biological Implants Committee-AAOS (Chairman 2011-2016)
2004 - Fellow, Biomaterials Science and Engineering (FBSE), the International Union of Societies, Biomaterials Science and Engineering
2002-2004 Board of Directors Orthopaedic Research Society
2001-2002 President- Society for Biomaterials
2000-2004 Board of Directors Society for Biomaterials
1998-2004 Member of the Biomedical Engineering Committee of AAOS
1995, 2000, 2007 Co-Chairman- AAOS and NIH workshop- Implant Wear and Total Joint Replacement

Honors

America's Top Doctors-20+years, Top Surgeons, Top Orthopedists, Compassionate MD, Honored Professionals

2023 Honorary Fellow, German Arthroplasty Society
2023 Keynote Speaker, Musculoskeletal Summit. Broome, Western Australia. July 2, 2023.
2023 Professor Michael Freeman Memorial Lecture, The European Federation of National Associations of Orthopaedics and Traumatology (EFORT) 2023 Meeting, Vienna Austria.
2022 ARCO – Best Presentation Award – ARCO Annual Meeting
2021 Nicholas Andre Lifetime Achievement Award, Association of Bone and Joint Surgeons

2018-2021	Distinguished Professor of Affiliated Zhongshan Hospital of Dalian University, Dalian, China
2019	Orthopaedic Research Society, Preclinical Models Section 3R Award: Organ-on-a-chip System for the Modeling of Synovial Joint Pathologies.
2018	The Journal of Orthopaedic Research, Excellence in Basic Science Award
2018	Patriotic Employer Award, Employer Support of the Guard and Reserve (ESGR), DOD, USA
2015	American Academy of Orthopaedic Surgeons Achievement Award
2010	2010 Lalor Foundation Merit Award, Society for the Study of Reproduction
2006, 2008-2009	USA Medical Student Research forums – Award as Mentor
2005	American Society for Biomechanics, Clinical Biomechanics Award
2003, 2006	Stanford University Medical Student Research Symposium - Mentor Award
2000	Clemson Award for Basic Research-Society for Biomaterials
1997, 2001	Society for Biomaterials
1997-1998	Orthopaedic Research Society
1995-1996	Western Orthopaedic Association
1994	American Orthopaedic Association
1983-1984	Canadian Residents Association - best paper award

C. Contributions to Science

1. Biomaterial Associated Inflammation and Mesenchymal-Innate Immune Cell Crosstalk. Joint replacements of the hip and knee are 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 lineage, which have broad implications for acute and chronic inflammatory processes in other organ systems throughout the body. Currently, our group is performing studies to mitigate acute and chronic inflammation by modulating the crosstalk between cells of the innate immune system, MSCs, vascular progenitors, and their lineage cells. 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, translation and function of pro-inflammatory cytokines, chemokines, and other factors, 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 and extend the longevity of joint replacements in humans.

1.1. Zhang N, Utsunomiya T, Lin T, Kohno Y, Ueno M, Maruyama M, Huang E, Rhee C, Yao Z, Goodman SB. MSCs and NF-kB sensing IL-4 over-expressing MSCs are equally effective in mitigating particle-associated chronic inflammatory bone loss in mice. Biomaterials. 2021;275:120972. PMID: 34186237.

1.2. Teissier V, Gao Q, Shen H, Li J, Li X, Huang EE, Kushioka J, Toya M, Tsubosaka M, Hirata H, Alizadeh HV, Maduka CV, Contag CH, Yang YP, Zhang N, Goodman SB. Metabolic profile of mesenchymal stromal cells and macrophages in the presence of polyethylene particles in a 3D model. Stem Cell Res Ther. 2023 Apr 21;14(1):99. PMID: 37085909.

1.3. Shinohara I, Tsubosaka M, Toya M, Lee ML, Kushioka J, Murayama M, Gao Q, Li X, Zhang N, Chow SK, Matsumoto T, Kuroda R, Goodman SB. C-C Motif Chemokine Ligand 2 enhances macrophage chemotaxis, osteogenesis, and angiogenesis during the inflammatory phase of bone regeneration. Biomolecules. 2023 18;13(11):1665. PMID: 38002347.

1.4. Toya M, Kushioka J, Shen H, Utsunomiya T, Hirata H, Tsubosaka M, Gao Q, Chow SK, Zhang N, Goodman SB. Sex differences of NF-κB-targeted therapy for mitigating osteoporosis associated with chronic inflammation of bone. Bone Joint Res. 2024 Jan 10;13(1):28-39. PMID: 38194999.

2. Tissue Engineering and Bone Healing: Bone loss can be due trauma, infection, end-stage 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 has identified the importance of different

chemokines and metabolic pathways 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. 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.

2.2. Lin T, Pajarinen J, Ohno Y, Nabeshima A, Lu L, Nathan K, Yao Z, Wu JY, Goodman SB. Increased NF-kB activity in osteoprogenitor-lineage cells impairs the balance of bone versus fat in the marrow of skeletally mature mice. Regen Eng Transl Med 2020; 6(1):69-77. PMID: 32377560.

2.2. Zhang N, Lo CW, Utsunomiya T, Maruyama M, Huang E, Rhee C, Gao Q, Yao Z, Goodman SB. PDGF-BB and IL-4 co-overexpression is a potential strategy to enhance mesenchymal stem cell-based bone regeneration. Stem Cell Res Ther. 2021;12(1):40. PMID: 33413614.

2.4. Kushioka J, Toya M, Shen H, Hirata H, Zhang N, Huang E, Tsubosaka M, Gao Q, Teissier V, Li X, Utsunomiya T, Goodman SB. Therapeutic effects of MSCs, genetically modified MSCs, and NFκB-inhibitor on chronic inflammatory osteolysis in aged mice. J Orthop Res. 2023 May;41(5):1004-1013. PMID: 36031590.

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 in vitro, in vivo, 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. Maruyama M, Moeinzadeh S, Guzman RA, Zhang N, Storaci HW, Utsunomiya T, Lui E, Huang EE, Rhee C, Gao Q, Yao Z, Takagi M, Yang YP, Goodman SB. The efficacy of lapine preconditioned or genetically modified IL4 over-expressing bone marrow-derived mesenchymal stromal cells in corticosteroid-associated osteonecrosis of the femoral head in rabbits. Biomaterials 2021;275:120972. PMID: 34186237.

3.2 Guzman RA, Maruyama M, Moeinzadeh S, Lui E, Zhang N, Storaci HW, Tam K, Huang EE, Utsunomiya T, Rhee C, Gao Q, Yao Z, Yang YP, Goodman SB. The effect of genetically modified platelet-derived growth factor-BB over-expressing mesenchymal stromal cells during core decompression for steroid-associated osteonecrosis of the femoral head in rabbits. Stem Cell Res Ther. 2021;12(1):503. PMID: 34526115.

3.3. Tsubosaka M, Maruyama M, Lui E, Moeinzadeh S, Huang EE, Kushioka J, Hirata H, Jain C, Storaci HW, Chan C, Toya M, Gao Q, Teissier V, Shen H, Li X, Zhang N, Matsumoto T, Kuroda R, Goodman SB, and Yang YP. The efficiency of genetically modified mesenchymal stromal cells combined with a functionally-graded scaffold for bone regeneration in corticosteroid-induced osteonecrosis of the femoral head in rabbits. J Biomed Mater Res A. 2023 Aug;111(8):1120-1134. PMID: 36606330

3.4. Cekuc MS, Ergul YS, Pius AK, Meagan M, Shinohara I, Murayama M, Susuki Y, Ma C, Morita M, Chow SK, Bunnell BA, Lin H, Gao Q, Goodman SB. Metformin modulates cell oxidative stress to mitigate corticosteroid-induced suppression of osteogenesis in a 3D Model. J Inflamm Res. 2024;17:10383-10396. PMID: 39654863

4. The MiniJoint: Together with the Universities of Pittsburgh and North Texas, we have developed rigorous, validated, human cell-derived microphysiological systems, or organ-on-a-chip as a novel model to study disease physiology and to test therapeutics. We have generated an *in vitro* miniature knee joint (**miniJoint**) that integrates the osteochondral, synovial, and adipose analogs derived from human pluripotent cells and challenged the miniJoint construct with stressors such as IL-1β to simulate disease states such as osteoarthritis.

4.1. Li Z, Lin Z, Liu S, Yagi H, Zhang X, Yocum L, Romero-Lopez M, Rhee C, O'Donnell B, Li EN, Hao T, Makarcyzk M, Goh KB, Alexander PG, Mahadik B, Fisher JP, Goodman SB, Bunnell BA, Tuan RS, Lin H. Human Mesenchymal Stem Cell-derived Miniature Joint System for disease modeling and drug testing. Adv Sci (Weinh). 2022;9(21):e2105909. PMID: 35436042

4.2. Makarczyk MJ, Hines S, Yagi H, Zhong A, Aguglia AM, Zbikowski J, Padget A, Gao Q, Bunnell BA, Goodman SB, Lin H: Using microphysiological system for the development of treatments for joint inflammation and associated cartilage loss—A Pilot Study. Biomolecules. 2023 17;13(2):384. PMID: 36830751

Complete List of Published Work in MyBibliography:
https://www.ncbi.nlm.nih.gov/myncbi/stuart.goodman.1/bibliography/public/