Ramkumar T. Annamalai

Assistant Research Scientist · Biomedical Engineering
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Research focus: Immunomodulatory Biomaterials, Musculoskeletal regeneration and Immunotherapies

Education

PhD in Biomedical Engineering — GPA 3.9/4.0
Wayne State University, Detroit MI — Fall 2009 – 2014
- Advisor: Professor Howard W.T. Matthew

MS in Biomedical Engineering — GPA 3.9/4.0
Wayne State University, Detroit MI — Fall 2007 – 2009
- Advisor: Professor Howard W.T. Matthew

Bachelor of Technology in Biotechnology — 1st class (Distinction)
Bharathidasan University, Trichy, India — Fall 2003 – 2007
- Thesis Advisor: Dr. Ashok Chacko

Work Experience

Assistant Research Scientist — Ann Arbor, MI
Department of Biomedical Engineering at the University of Michigan — Aug 2017 - Present
- Supervisor: Dr. Jan Stegemann, Mentor: Dr. David Kohn.

Postdoctoral Research Fellow — Ann Arbor, MI
Department of Biomedical Engineering at the University of Michigan — Jun. 2014 - July. 2017
- Supervisor: Dr. Jan Stegemann

Graduate Research Assistant — Detroit, MI
Department of Chemical Engineering at Wayne State University — Jan. 2013 - Feb. 2013
- Supervisor: Dr. Howard Matthew

Thomas C. Rumble University Graduate Fellow — Detroit, MI
Department of Biomedical Engineering at Wayne State University — 2011 - 2012
- Supervisor: Non-service award overseen by the department chair Dr. Albert King

Research Fellow — Vellore, India
Department of Gastroenterology at Christian Medical College — Winter 2007
- Supervisor: Dr. Ashok Chacko

Publications

Injectable osteogenic microtissues containing mesenchymal stromal cells conformally fill and repair critical-size defects — Biomaterials
Annamalai RT, Hong, Schott, Tiruchinapally, Levi and Stegemann — 2019; 208:32-44

Harnessing macrophage mediated pathways for degradation of gelation microspheres for Spatiotemporal Control of BMP2 Release — Biomaterials
Annamalai RT*, Turner P, Carson W, Kunkel S, Levi B and Stegemann J — 2018; 161:216-227

Vascular network formation by microvascular endothelial cells in modular fibrin microtissues — ACS Biomaterials
Annamalai RT, Rioja, Putnam and Stegemann — 2016; 2(11):1914-25

Transport Analysis of Engineered Liver Tissue Fabricated Using a Capsule-Based, Modular Approach
Annamalai RT and Matthew HW
Ann Biomed Eng
2019; 47(5):1223-36

Biofabrication of injectable fibrin microtissues for minimally-invasive therapies-Application of surfactants
Annamalai RT, Naik, Prout, Putnam, and Stegemann
Biomedical Materials
2018; 13:045005

Collagen Type II enhances chondrogenic differentiation in agarose-based nodular microtissues
Annamalai RT, Mertz, Daley and Stegemann
Cytotherapy
2016; 18(2):263-77

A glycosaminoglycan based, modular tissue scaffold system for rapid assembly of perfusable, high cell density, engineered tissues
Annamalai RT, Armant and Matthew
PLoS One
2014; 9(1):e84287

Endothelial sprouting and network formation in collagen- and fibrin-based modular microbeads
Rioja AY, Annamalai RT, Spencer, Putnam and Stegemann J
Acta Biomaterialia
2016; 29:33-41

Multimode ultrasound viscoelastography for interrogation of mechanical properties in heterogeneous biomaterials
Hong X, Annamalai RT, Kemmerer T, Deng C, Stegemann, J
Biomaterials
2018; 178:11-22

Evaluation of salivary cytokines for diagnosis of both trauma-induced and genetic heterotopic ossification
Sung, Chung, Habbouche, Cholok, Allen, Annamalai RT, Priest, Loder, Li, Stegemann, Kunkel and Levi
Front Endocrinol
2018; 161:216-227

Bioresponsive Microspheres for On-demand Delivery of Anti-inflammatory Cytokines for Articular Cartilage Repair
Park E, Hart M, Rolauffs B, Stegemann J, Annamalai RT*
bioRxiv
2019: 636886

Longitudinal monitoring of osteogenesis and vasculogenesis in ECM matrices using multimode ultrasound viscoelastography
Annamalai RT, Hong X, Hobson E, Deng C, Stegemann, J
Under Review
2019

Tuning the immune response to improve musculoskeletal extremity trauma wound healing through macrophage directed TGFβ1 modification
Sorkin M, Cholok D, Lee C, Loder BS, Annamalai RT, Li J, Li S, Mishina Y, Levi B
Under Review
2019

Conference Presentations (Podium)

Bone Regeneration in a Critical-Sized Calvarial Defect is Potentiated by Macrophage-Mediated Release of BMP2
Annamalai RT, Turner, Levi, Kunkel, and Stegemann
BMES
Atlanta, 2018

Harnessing the Regenerative Potential of Macrophages Using Instructive Extracellular Matrices
Annamalai RT, Carson, Levi, Kunkel, and Stegemann
BMES
Phoenix, 2017

Multiphase Osteogenic and Vasculogenic Microtissues Support Endothelial Cell Network Formation and Enhance the Mineralization Potential of MSCs
Annamalai RT, Schott, Hong, Tiruchinapally, Levi and Stegemann
BMES
Phoenix, 2017

Harnessing Macrophage-Mediated Secretion of BMP2 and VEGF for Bone Tissue Engineering — TERMIS
Annamalai RT, Carson, Agarwal, Kunkel, Levi and Stegemann — San Diego, 2016

Injectable, Cell-Seeded, Modular Microtissues for Bone Regeneration in Critical Size Defects — BMES
Annamalai RT, Hong, Agarwal, Levi and Stegemann — Minneapolis, 2016

Macrophage-mediated Degradation of Gelatin Microspheres for Release of BMP2 — BMES
Annamalai RT, Turner, Carson and Stegemann — Minneapolis, 2016

Network Formation by Microvascular Endothelial Cells within Modular Fibrin microtissues — TERMIS
Annamalai RT, Rioja AY, Putnam and Stegemann — Boston, 2016

Rapid Assembly of Perfusable and Vascularizable Modular Constructs for Hepatic Tissue Engineering — Society for Biomaterials
Annamalai RT and Matthew — Denver, 2014

Tissue Density Culture in GAG-Based Microcapsules as a Foundation for Modular Tissue Engineering — Society for Biomaterials
Annamalai RT, Armant and Matthew — Seattle, 2010

Selected Conference Presentations (Poster)

Bioresponsive Microspheres for on-demand Delivery of Anti-inflammatory Cytokines for Inflammatory Arthritis — SFB
Mertz, Daley, and Stegemann, Annamalai RT — Seattle, 2019

Ultrasound Guided Non-Invasive Delivery of Modular Microtissues for Bone Regeneration — TERMIS
Annamalai RT, Hong, Agarwal, Levi and Stegemann — Minneapolis, 2016

Material properties and differentiation potential of collagen-II based 3D microbeads for cartilage tissue engineering — SFB
Annamalai RT, Mertz, Daley, and Stegemann — Charlotte, 2015

Modular Biomaterial Scaffolds for Scalable Tissue Assembly and Rapid Vascularization — SFB
Annamalai RT, Hong, Agarwal, Levi and Stegemann — Minneapolis, 2013

Modular Biomaterial Systems for Rapid and Functional Vascularization — SFB
Annamalai RT, and Matthew — Boston, 2013

Engineering ECM-Based Modular Scaffolds for Perfusion and Functional Vascularization — BMES
Annamalai RT, Armant, and Matthew — Atlanta, 2012

Modular Tissue Engineering with GAG-Based Microcapsules: Assembling 3D Tissue Structures — TERMIS
Annamalai RT, Armant, and Matthew — Orlando, 2010

Engineering Differentiated Cells and Stem Cells Using GAG-Chitosan Capsules as Tissue Modules — BMES
Annamalai RT, Armant, and Matthew — Austin, 2010

Teaching Experience

Guest Lecturer: University of Michigan, Ann Arbor

Introduction to Tissue Engineering (BME 474) — Since Fall 2015
Topics: Angiogenesis, vascular tissue engineering and mass transfer in biological systems
Instructor: Dr. Ariella Shikanov

Advances in Tissue Engineering (BIOMATLS 584) — Since Fall 2016
Topics: Vascular tissue engineering and microscale technologies for tissue vascularization
Instructor: Dr. David Kohn

Bioreaction Engineering and Design (BME 321) — Since Win 2018
Topics: Physical and transport analysis of perfusion bioreactors for liver tissue engineering
Instructor: Dr. Ariella Shikanov

Invited Lecturer

Tissue Engineering, Lawrence Technological University, Southfield, MI — 2013-2014
Topics: 3D cell cultures, modular tissue engineering, and perfusion bioreactors design and development. Instructor: Yawen Li.

Tissue Engineering and Hybrid Systems: Wayne State University, Detroit, MI — 2009-2014
Topics: Mammalian cell culture techniques, cell growth kinetics, Stem cells for tissue engineering and regenerative medicine, extracellular matrix components, bioreactor design and development. Instructor: Howard Matthew.

Teaching Assistant

Experimental Methods in Biomaterials Lab (BME Level 5000) — 2009-2012
Supervised grad/undergrad students to perform animal cell culture techniques, immunostaining, immunohistochemistry, fluorescence and phase contrast microscopy, scaffolding, live/dead assays, proliferation assays and biochemical assays.

Grant Applications

National Institute of Health, R01 NIAMS ($1,250,000) — Role: Co-I
Title: Rational design of an engineered barrier membrane to support graft performance in segmental bone defect healing — Jun 2019 (Pending)

National Institute of Health, R21 NIAMS ($275,000) — Role: PI
Title: Immunomodulatory cell-therapy for critical bone defects — Feb 2019 (Pending)

MI Institute for Clinical & Health Research, Pathway to independence ($50,000) — Role: PI
Title: Immunomodulatory biomaterials for non-unions — Apr 2019 (Pending)

NIH Pathway to Independence Award, K99/R00 NIAMS — Role: PI
Title: Harnessing macrophage regulation of heterotopic ossification for therapeutic bone regeneration — 2017 (Scored, Not funded)

MiCHR, Postdoctoral Translational Scholars Program ($100,000) — Role: PI
Title: Harnessing macrophage biology for therapeutic bone formation and clinical prognosis — 2016 (Not funded)

Honors & Awards

2016	**Winner**, Logo design contest Michigan Postdoctoral Association of the College of Engineering
2012	**Travel Award**, Biomedical Engineering National Society (BMES), USA
2012	**Student Appointee** , BME Chair Search Committee (Appointed by Dean), Wayne State University
2011	**Thomas C. Rumble Fellowship**, Wayne State University, USA
2010	**Travel Award**, Biomedical Engineering National Society (BMES), USA
2007	**Best Oral Presentation**, Biotechnology National Symposium, Arunai Engineering College, India

Academic Service & Campus Affiliations

2014-	**Journal Reviewer**, Carbohydrate Polymer, International Journal of Materials Research, Scientific reports, Cellular Physiology & Biochemistry, and Biomaterials.
2014-	**Project Reviewer**, BME 420/430 Design course
2018	**Abstract Reviewer**, Biomedical Engineering National Society (BMES)
2017-	**Chair**, Michigan Postdoctoral Association for College of Engineering
2015	**Session Co-chair (Podium presentations)**, TERMIS - World Congress, Boston.
2017	**Member, Organizing Committee**, Biomaterials Day, University of Michigan
2016	**Session Co-chair (Podium presentations)**, TERMIS-North America, San Diego
2011-12	**President**, Biomedical Engineering Society- Wayne State Chapter
2010-14	**Committee Member**, Due Process Committee, Wayne State University
2011	**Chair, Organizing Committee**, Biomedical Engineering Research Day, Wayne State University

References

Jan Stegemann, Ph. D.
Professor of Biomedical Engineering, University of Michigan
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Benjamin Levi, MD.
Assistant Professor of Surgery, University of Michigan
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Howard W.T. Matthew, Ph.D.
Professor of Chemical Engineering and Material Sciences, Wayne State University
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