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ABSTRACT BOOK

WORLD CONFERENCE ON

Biomaterials and Regenerative Medicine

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Table Of Contents

6	"Title: 1 “How to Achieve a Disease Free Life with Longevity in view “Evidence and Insights” 2. “Rooted in Science, Driven by Results: Validated Protocols Targeting Disease at the Source” "
	Philip Bresnahan, *USA*
7	Title: Electronic Stimulation in a Dynamic Enhanced System as a Single-input Cue for Regulating Neurovascularized Bone Regeneration
	Jiajing Tang, Radboud University, *The Netherlands*
8	Title: Sustained release of therapeutics via artificial secretory granules
	Dr. Marianna T. P. Favaro, *Autonomous University of Barcelona, Spain*
9	Title: Biomaterials composed of doubly (His)6-tagged proteins
	Dr. Guy Patchornik, *Ariel University, Israel*
10	Title: Advanced Processing trhough Acumulative Roll Bonding and 3D printing of Multiprincipal Beta Ti-Nb-Zr alloy for Implants
	Dr. Conrado Ramos Moreira Afonso, *Universidade Federal de São Carlos, Brazil*
11	Title: Angiogenic lipid-based drug delivery system (PhytoSolve) for treatment of a thin endometrium in animal model
	Dr. Mehdi Mehdizadeh, *Iran University of Medical Sciences, Iran*
12	Title: Effect Of A Clay Material On Alveolar Bone Healing In Wistar Rats
	Dr. AKON-LABA Akalé Bernadette, *School of Dentistry, UP Biomaterials, Ivory Cost*

13	Title: Covalent Conjugation of Quercetin to Oxidized β-Cyclodextrin via Acid-Catalyzed Condensation: A Two-Step Strategy for Enhanced Solubility and Antioxidant Activity.
	Dr. Feray Bakan Misirlioglu, *SUNUM Sabanci University, Turkey*
14	Title: A Resurfacing-Regenerative Approach to Repair Osteochondral Defects
	Melissa A. Grunlan, *Texas A&M University, USA*
15	Title: Engineering Bioactive Monetite Scaffolds to Enhance Stem Cell Osteogenesis and Bone Healing
	Dr. Vineetha Jayawarna, *University of Glasgow, Glasgow, United Kingdom*

Featured Speakers

16	Title: Development of a Chorioallantoic Membrane (CAM)-Based Angiogenesis Platform for Enhancing Neovascularization in Renal Organoid Constructs
	Dr. Roopa Chalasani, *Wake Forest University School of Medicine, USA*
17	Title: Comparative evaluation of strategies for incorporating BMP-2 with regard to the osteoinductive potential of PLLA scaffolds for guided bone regeneration.
	Dr. Tomasz Gredes, *Technische Universität Dresden, Germany*
18	Title: Cord Blood-Derived Mesenchymal Stem Cells in the Management of Autism Spectrum Disorder.
	Dr. Amina Al Dababsekh, *Ukraine*

19	Title: Laser-Activable Nanoparticle-Infused Gel for hard-to-heal Diabetic Wound.
	Mr. Shivam Otavi, *National Institute of Pharmaceutical Education and Research (NIPER), India*
20	Title: Mechanically Robust Gentamicin-Linked Hybrid Hydrogels: Prolonged Infection Control in Burn Care
	Dr. A. Aslihan Gokaltun, *Harvard Medical School, Massachusetts General Hospital, USA*
21	Title: Engineering a regenerative mesenchyme for age-related diseases therapy: example of periodontitis
	Ms. Jeanne Minvielle Moncla, *University of Toulouse, France*
22	Title: Transparent Sodium Alginate/Polyvinyl Alcohol Hybrid Casting Films for Corneal Stromal Regeneration
	Amin Orash Mahmoudsalehi, *School of Engineering and Science, Tecnologico de Monterrey, Monterrey, Mexico*
23	Title: Pre-Vascularized Collagen Hydrogels as a Platform for Regenerative Tissue Models
	Ms. YuChieh Wu, *Institute of Physiology of the Czech Academy of Sciences, Czech Republic*
24	Title: Advanced Materials and Digital Strategies in 3D Bioprinting: Breakthroughs in Multimaterial Fabrication, Embedded Bioinks, and AI-Driven Clinical Translation
	Degu Melaku Kumelachew, *Bahir Dar University, Ethiopia*

25	Title: Fabrication of Enamel-Inspired Composites by Polymer infiltration of SiOC Columnar Ceramic Structures Produced by DLP
	Sergio Moreno Martínez, *University of Extremadura, Spain*
26	Title: Developing an autologous human nasal tissue-engineered cartilage implant for facial reconstruction surgeries
	Tatyana Kuperman, *Tel Aviv University and Sheba Medical Center, Israel*
27	Titel: Altering Smooth Muscle Cell (SMC) Identification and Differentiation States to Understand the Role of SMC in Normal and Pulmonary Arterial Hypertension Phases.
	Ayat J Alansari, *University of East Anglia, Saudi Arabia*
28	Title: Scaffolds Decorated with Bioactive Graphene Quantum Dots for Diabetic Wound Healing
	Dr. Didem Demir, *Tarsus University, Turkiye*
29	Title: 3D printed bioactive coated scaffolds boost osteogenesis and angiogenesis via the regulation of scaffold microstructure
	Dr. Dongxu Ke, *Nanjing University Suzhou Campus, China*
30	Title: Multiresponsive Nanorobots: Manipulation Strategies and Biomedical Applications
	Ms. ZHANG Kejia, *University of Hong Kong, Hong Kong*
31	Title: Spatially Programmed Delivery of Therapeutic Exosomes via Microneedle Patches for Alveolar Bone Regeneration
	Dr. Jiaxin Guo, T*he University of Hong Kong, Hong Kong SAR*

32	Title: Enhancing mRNA Therapeutics for Laminopathy: Investigating Diverse Delivery Systems
	Ms. Tsui Sharmane Fion, *Hong Kong*
33	Title: Real-time insights into biomaterial-host interactions: intravital imaging of the cellular and infectious response to wettability-tuned PDMS coatings
	Ms. Elles Catharina Boonstra, U*niversity Medical Center Groningen, Netherlands*
34	Title: Modeling Breast Cancer Extracellular Vesicle–Mediated Degradation of the Lymphatic Glycocalyx using a 3D Organ-on-Chip Platform
	Justin Ching Yin Lau, *Cornell University, USA*
35	Title: A novel bi-directional and bi-temporal delivery system for enhancing intrasynovial tendon repair
	Seth Kinoshita, *Georgia Institute of Technology, USA*
36	Title: Spatiotemporal Mapping of Lung Tissue Mechanics During Breast Cancer Metastasis Using a Novel In-Plane Actuation Platform
	Madison O'Brien, *Purdue University, USA*
37	Title: Development of Antimicrobial Biodegradable Sutures Using Polymeric and Deep Eutectic Reactive Systems via Hot-Melt Extrusion
	Mrs. Ganga Neeharika Addula, *Queen's University Belfast, UK*
38	Title: A Promising Injectable Chitosan/Pectin Methacrylate Hydrogel Infused with Cnicin for Peripheral Nerve Repair
	Yousra Mohamed, *Newcastle University, United Kingdom*

39	Title: Development of Peptide–Chitosan Hydrogel Composites for Wound Healing Applications
	Sara Ali Hosseinzadeh, *The University of Manchester, UK*
40	Tittle: Valorization of Eggshell Waste into Bioceramic-Coated Textile Scaffolds for Bone Tissue Engineering
	Dr. Julia Bellvik, *University of Borås, Sweden*
41	Title: The role of molecular biology in the management of colorectal cancers
	Dr. Kemache Bilel, *Medical Biology Department - Beni Messous University Hospital – Algiers*
42	Title: Innovative Protein-Based Formulations from Hevea brasiliensis Latex for Advanced Tissue Regeneration
	Dr. Natalia Lemos Chaves, *Victor Hugo Braga da Silva; Suelia de Siqueira Rodrigues Fleury Rosa; Marcella Lemos Brettas Carneiro, Brazil*
43	Title: Eco-friendly Extraction of Bioactive Keratin Using Deep Eutectic Solvent and Its Application in Keratin–PCL Nanofiber Scaffolds for Wound Healing
	Ms. Amrita Das, *Presidency University, India*
44	Title: Plant-Based Nutraceuticals and Their Biomedical Applications
	Dr. Mukul Machhindra Barwant, *Commerce and Science College, India*
45	Title: Surface-Engineered Nanostructure Lipid Carrier for Targeted Delivery of a CDK Inhibitor for Breast cancer therapy
	Dr. Nida Nehal, *School of Pharmaceutical Education and Research, India*

46	Title: Emerging Sensing Platforms for Epilepsy Care and Management
	Vaibhav Thirumalai, *Case Western Reserve University, USA*
47	Title: Cellular Uptake and Nuclear Localization of Biomimetic Proteoglycans
	Annika R. Bergstrom, *Villanova University, USA*
48	Title: Optimizing Polymer Nanoparticle-Mediated Nucleic Acid Delivery and Endosomal Escape for Inhibition of Endothelial Inflammation
	Valerie Lallo, *Villanova University, USA*
49	Title: Enhancing Granular Hydrogel Stability via Surface Modulation for Improved Frictional Inter-Particle Interactions
	Navid Tavoosi, *McGill University, Canada*
50	Title: An adhesive hydrogel enabling suture-free cell delivery across osteochondral tissues
	Dr. Peyman Karami, *Institute of Bioengineering, School of Engineering, Switzerland*
51	Title: Arteether Nanoemulsion for Enhanced Oral Efficacy Against Plasmodium yoelii nigeriensis: A Bioavailability-Driven Approach.
	Mrs. Priyanka Chaturvedi, *Jai Narain College of Pharmacy, India*
52	Title: Stem Cell Therapy in Regenerative Medicine: Advances, Applications, and Future Perspectives
	Dr. Venkadeswaran Karuppasamy, *India*

53	"Title: Enhanced in vivo Chronic Full-Thickness Wounds healing with Antimicrobial Chitosan- Graphene Nanocomposites "
	Dr. Priyanka Chhabra, *Amity University Noida, India*
54	Title: Extrusion based multifunctional 3D printed scaffold for wound healing application
	Menaga.S, *Vellore Institute of Technology, India*
55	Title: Adsorptive performance of green-synthesized ZnO nanoparticles: RB-5 dye removal, kinetics, and antioxidant evaluation for environmental and biomedical applications
	Mr. ADIL USMAN, *Pakistan*
56	Title: Asymmetric mechanical behavior and pre-osteoblast differentiation in Ti6Al4V minimal-surface bone-analogues: the role of pore topology
	Bijay Kumar Karali, *Indian Institute of Science, India*
57	Title: Engineering Bioactive PCL–Nanocellulose–Hydroxyapatite Composites: A MeltProcessed Route to Bioresorbable Orthopedic Fixation Devices
	Nilesh R. Bhoi, *Indian Institute of Technology Bombay, India*
58	Title: Bioactive Osseointegrative Antimicrobial Coating for Titanium Implants: A facile solution for Cementless Fixation and Infection Prevention
	Subhankar Maity, *Jawaharlal Nehru Centre for Advanced Scientific Research, India*

59	Title: EHD techniques for biostabilizing food and functional biomolecules
	Subith Cheeyattil, *National Institute of Technology, India*
60	Title: High-strength biocompatible implant for fracture fixation
	Madhulika Narayan, *India*
61	Title: BioDentX: Bio-Intelligent Self-Healing Dental Biomaterial for Enamel Regeneration
	Afra Samreen, *Rajiv Gandhi University of Health Sciences, India*
62	"Title: Exploring the Potential of Alginate-Starch based Bioink Composites for Soft Tissue Engineering using 3D Bioprinting "
	Ms. Antara Poi Raiturker, *Birla Institute of Technology and Science, India*
63	"Title: Harnessing Antimicrobial Superhydrophobic Biomaterials for Subsiding Urinary Tract Infections and Improving Women Health "
	Dipanjana Patra, *Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), India*
64	Title: Easily Injectable, Organic Solvent-Free Self-Assembled Hydrogel Platform for Endoscope Mediated Gastrointestinal Polypectomy
	Ms. Hitasha Vithalani, *Indian Institute of Technology, India*
65	Title: A Soft Solution: Spongy Biodegradable Scaffold for Localized Endometriosis Therapy
	Lisha Awasthi, *Indian Institute of Technology Bombay, India*

66 Title: Injectable Polysaccharide-Based Composite Hydrogel for Regeneration of Critical-Sized Bone Defects

Malika Arora, *Institute of Nano Science and Technology, India*

67 Title: Amyloid hydrogel as a scaffold for the development of patient centric-breast cancer organoids for high-throughput screening of anticancer therapeutics.

Nitisha Gahlot, *Indian Institute of Technology Bombay, India*

68 Title: Sodium Alginate Hydrogels Embedded with Copper Co-Crystals and Zinc Oxide Nanoparticles for Advanced Wound Healing Applications

Renu Devi, *Indian Institute of Technology Ropar, India*

69 Title: Effect of crosslinkers on Soldium Alginate-based hydrogels intended for skin tissue constructs

Shanaia Tabitha da Cruz Fernandes, *Birla Institute of Technology and Science, India*

70 Title: Enhanced Anticancer Activity of Bimetallic Nanoparticles through Photothermal Synergy

Tanisha Gupta, *National Institute of Pharmaceutical Education and Research (NIPER), India*

71 Title: Nanomaterial doped Polyethersulfone Hollow Fiber Membranes for Bioartificial Kidney and Hemodialysis Applications

Nidhi Pandey, *Indian Institute of Technology Bombay, India*

72 Title: Amniotic membrane ecm hydrogels: a regenerative biomaterial for diabetic wound healing

Pratibha, *BRIC-Translational Health Science and Technology Institute, India*

Dr. David I. Devore
Graplon Technologies, USA

1. "Polyelectrolyte Surfactant Nanovectors for the Treatment of Pseudomonas aeruginosa Biofilm Lung Infections

Abstract

Cystic fibrosis (CF) is a genetic disease with a high mortality rate due largely to chronic lung infections of Pseudomonas aeruginosa and other microorganisms. These infections are difficult to treat because of bacterial biofilms within the thickened CF sputum that together inhibit the efficacy of antimicrobials. The P. aeruginosa lung infections generally require daily inhalation treatments with cationic antimicrobials (CA), typically tobramycin or colistin. Here we describe amphiphilic graft polyelectrolyte surfactants (PS), designed on the basis of their thermodynamic properties, that can provide improved mucus penetration and efficient areosolized nanovector delivery of CA's. The PS, comprised of poly(alkylacrylic acids) grafted with polyetheramine pendent chains, self-assemble into PS-CA nanoparticles that enable controlled CA delivery. PS-CA nanovectors are shown to enhance activity against planktonic and biofilm cultures of P. aeruginosa strains derived from CF patient clinical isolates. Membrane potentials and PS-CA uptake demonstrate that the PS-CA directly associate with the bacterial cell membranes. A commercial nebulizer commonly employed by CF patients is used to demonstrate that aerosolized PS-CA retain their in vitro physical properties, antimicrobial activity and non-cytotoxicity. Using healthy mice, in vivo biodistribution and inflammatory marker expressions are compared following PS-CA inhalation or intraperitoneal injection. Minimal inflamatory response is observed along with over 70% PS retention in the lungs following inhalation compared to less than 5% following injection, which demonstrate the potential promise of aerosolized PS-CA nanomedicines.

Tittle: 2. “Can polymeric surfactants block cancer cell fusion and metastasis?”

Abstract

The World Health Organization estimates that there will be nearly 10 million deaths worldwide from cancer in 2025. For most cancers, current therapeutic approaches generally do not permanently eradicate metastases, and it is estimated that metastases account for 90% of cancer-related deaths. While the underlying cellular processes leading to metastases are not fully defined, there is extensive evidence that the fusion of cancer cells with each other or with diverse normal cells is a probable driving factor for metastasis. We present here compelling evidence that a family of biocompatible “anti-fusion” polymeric surfactants (AFPS), designed on the basis of their thermodynamic interaction properties with phospholipid membranes, can selectively target cancer cells and inhibit their fusion without affecting normal cells. The AFPS are readily synthesized to provide a broad range of thermodynamic hydophile:lipophile balances (HLB) and Hansen solubility parameters (δT) properties that promote self-assembly into nanoparticles of controlled particle sizes suitable for therapeutic applications. The AFPS are shown to selectively insert in phospholipid membranes at surface pressures characteristic of cancer cells, which are more disrupted and fluid than normal cell membranes. The AFPS are shown to inhibit both the spontaneous and PEG-enhanced fusion of cancer cells in culture. The AFPS provide strong non-covalent interactions with membrane phospholipids and cholesterol, as well as enabling controlled in vitro and in vivo delivery of hydrophobic chemotherapeutics such as paclitaxel. These results suggest that properly designed polymeric surfactants might provide a new paradigm in metastatic cancer treatment.

Biography

David I. Devore, Ph.D., is the CEO of Graplon Technologies, LLC, a nanomedicine start-up. He is a consultant on nanomedicine research at Rutgers University, where he was previously a research faculty member at the Center for Biomaterials and then a Visiting Scientist in Biomedical Engineering. He also served for 4 years as a Principle Investigator on biofilm infections at the US Army Institute of Surgical Research. Prior to Rutgers and USAISR, Dr. Devore had a long, successful research managment career in the chemical industry. He has invented, developed and patented a wide array of products for biomedical and industrial applications. He received his doctorate in physical chemistry from Rutgers University and did postdoctoral research in neurophysiology and biophysical chemistry at Columbia University and the University of California, Berkeley.

Dr. Lydie Ploux
Universite de Strasbourg, France

Bio-based and biomimetic strategies to treat biofilms without antibiotics

Abstract

Bacterial biofilms, central to healthcare-associated infections (HAIs), pose a significant challenge in relation to biomaterials. As resistance to conventional, antimicrobial treatments escalates, innovative approaches targeting pathogens are needed. Inspired by the nature, we are developing two new approaches of hydrogel biomaterials, respectively based on bacteriotherapy, which uses probiotic to treat or mitigate bacterial infections, and on natural substances targeting bacterial functional amyloid fibrils, which are involved in the formation and the matrix of bacterial biofilms. The first approach succeeded in completely inhibiting the growth of Pseudomonas aeruginosa using adequate combinations of prebiotic and probiotic in agarose hydrogels, based on a synergistic effect triggered by the pathogen. The second approach resulted in strong reductions of amyloid content of Escherichia coli and Staphylococcus epidermidis biofilms, based on the ability of two natural compounds to disassemble bacterial amyloid sequences. Taken together, these two projects provide a picture of the research currently conducted to find new ways to reduce the biofilm risk associated to biomaterials without using antibiotics, thus also reducing the risk of emergence and spread of antimicrobial resistance.

Biography

Lydie Ploux is a research director at the National Centre for Scientific Research (CNRS) for more than 25 years after her PhD at UTC Compiègne University and Paris XI University (France) and a post-doctoral position at the Forschungszentrum Jülich (Germany). She conducts research at BIOMAT, the Biomaterials & Bioengineering joint research unit (UMR_S 1121/EMR 7003) of Inserm, CNRS and the University of Strasbourg. She is a member of the Executive Committee of

BIOMAT and the leader of the group "Antimicrobial Materials" of BIOMAT. She studied physics, biomedical engineering and physiotherapy, and is an expert for bacterium- and biofilm-material biointerfaces, and antibacterial surfaces.

Dr. Indra Wibowo
School of Life Sciences and Technology, Institut Teknologi Bandung, Indonesia

Sustainable Zinc Oxide Nanoparticles: Integrating Green Synthesis, Bioactivity, and In Vivo Safety for Regenerative Medicine

Abstract

Green synthesis of metal oxide nanoparticles using natural bioresources has emerged as a promising strategy to develop biocompatible biomaterials for regenerative medicine. Zinc oxide nanoparticles (ZnO NPs) are particularly attractive due to their physicochemical tunability, bioactivity, and regulatory acceptance. However, systematic integration of plant-derived green synthesis, functional bioactivity, and in vivo biocompatibility assessment remains limited. In this study, ZnO nanoparticles were biosynthesized using three distinct natural sources: (i) Fe'i (Musa troglodytarum) and Cavendish (Musa acuminata) banana extracts, (ii) methanolic propolis extract, and (iii) papaya (Carica papaya) fruit extract. Aqueous and methanolic extraction routes were employed to modulate phytochemical composition. The resulting ZnO NPs were comprehensively characterized using UV–Vis spectroscopy, X-ray diffraction, FTIR, SEM/TEM, particle size analysis, and zeta potential measurements. Biological performance was evaluated using zebrafish (Danio rerio) models, including acute toxicity screening, embryonic development assessment, inflammatory response modulation (caudal fin amputation), immune gene expression, and metabolic enzyme inhibition assays. All green-synthesized ZnO NPs exhibited a hexagonal wurtzite crystalline structure with nanoscale crystallite sizes (~12–50 nm) and stable surface charges. Banana- and propolis-derived ZnO NPs demonstrated significant anti-inflammatory activity, evidenced by reduced neutrophil and macrophage recruitment in zebrafish injury models, comparable to dexamethasone treatment. Propolis-mediated ZnO NPs

further showed strong antioxidant and antidiabetic activities, with high inhibition of α-amylase and α-glucosidase enzymes. Toxicological evaluation of papaya-derived ZnO NPs revealed dose-dependent embryotoxicity, with concentrations below 10 mg/L showing minimal effects on zebrafish survival, hatching, and morphology. At higher concentrations, ZnO NP exposure induced immune-related gene expression (TNF-α, IL-1, IL-10), highlighting the importance of dose optimization. Collectively, these findings demonstrate that green-synthesized ZnO nanoparticles derived from diverse bioresources exhibit favorable bioactivity–biocompatibility profiles relevant to regenerative medicine. The integration of sustainable synthesis, functional biological efficacy, and vertebrate in vivo safety assessment positions these ZnO nanomaterials as promising candidates for anti-inflammatory, metabolic, and tissue-regenerative biomaterial applications, while emphasizing the need for controlled dosing and mechanistic optimization.

Biography

Dr. Indra Wibowo finished his PhD in Biomedics from Center for Genomic Regulation-Pompeu Fabra University, Barcelona, Spain. Until now, Dr. Wibowo is an Associate Professor at the School of Life Sciences and Technology (SITH), Institut Teknologi Bandung (ITB), Indonesia. His expertise spans developmental biology, physiology, regenerative medicine, and biomaterials, with a strong emphasis on zebrafish models for studying inflammation, neuroprotection, and tissue regeneration. Dr. Wibowo's research integrates green nanotechnology, natural product–based therapeutics, stem cells, and multi-omics approaches to support translational biomedical and bioindustry applications. He has authored numerous peer-reviewed publications in biomaterials, nanomedicine, and regenerative biology, and actively supervises undergraduate to doctoral students. In addition to his research role, Dr. Wibowo is deeply involved in academic leadership, curriculum development, and quality assurance at ITB. His work is driven by a commitment to sustainable science, interdisciplinary collaboration, and the advancement of life-science-based innovations for health and society.

Prof. Stelios T. Andreadis
University at Buffalo, USA

Restoring Aged Skeletal Muscle Function through Partial Reprogramming and Metabolic Intervention

Abstract

We discovered that ectopic expression of pluripotent transcription factor, NANOG completely restored the mitochondrial function in senescent stem cells and that NANOG-driven rejuvenation led to metabolic reprogramming of senesced cells to the state of young proliferating cells. Using several models of cellular senescence, we show that senescent cells exhibited severe mitochondrial dysfunction, as evidenced by significantly reduced mitochondrial membrane potential, reduced respiratory function and excessive accumulation of reactive oxygen species (ROS). To delineate cell metabolic profile, we employed Seahorse analyzer and observed complete restoration of mitochondrial respiratory capacity in aged MSCs after NANOG overexpression. Metabolomic analysis revealed increased dependance of senescent cells on glutamine to meet their bioenergetic demand and this was confirmed by increased glutaminase (GLS) activity in aged cells. This observation also held true for our in-vivo study, where we observed increased GLS expression and activity in heart, aorta and skin of progeric (LAKI) as well as geriatric mice. Enhanced deamination of glutamine with senescence results in accumulation of toxic end-product, urea leading to detrimental consequences for mitochondrial function and DNA damage. Interestingly, inhibition of GLS activity in senescent cells by CB-839 decreased urea accumulation and partially restored mitochondrial function, decreased ROS and DNA damage. Furthermore, we examined the effects of CB-839 on LAKI mice and observed decreased age-associated ROS and urea accumulation in heart, skin and muscle, concomitant with improved mitochondrial function and physical performance. Hence, inhibition of GLS activity rejuvenated mitochondrial function and led to amelioration of aging hallmarks including physical performance of aged prematurely mice.

Prof. Sabrina Arcaro
Universidade do Extremo Sul Catarinense, Brazil

1. Polymeric Matrix Microparticles with Mesoporous Hydroxyapatite for the Controlled Release of Attractants against Aedes aegypti

Abstract

The control of Aedes aegypti, the main vector of arboviruses such as dengue, Zika, and chikungunya, remains one of the major global public health challenges. The mosquito's high adaptability to urban environments and rapid reproductive cycle make long-term control strategies particularly difficult. Among emerging alternatives, the use of attractant traps has shown promise both for monitoring and population reduction, especially when combined with chemical attractants such as lactic acid. However, the limited stability of these compounds and the high cost of longlasting commercial products—mostly imported—highlight the need for national technologies that combine efficiency, affordability, and sustainability. In this context, the present study aimed to develop polymeric microparticles based on a matrix of polylactic acid (PLA) and sodium alginate, incorporating mesoporous hydroxyapatite derived from tilapia bones, with the goal of achieving controlled and prolonged release of chemical attractants against Aedes aegypti. The hydroxyapatite was synthesised from biological waste through thermal cleaning, comminution, treatment at 600 °C, and high-energy milling. It was characterised by thermal analysis (DSC/TG), X-ray diffraction, and a 2^2 factorial design to determine crystallinity and crystallite size. Microparticles were produced using the extrusion technique by combining three systems: an aqueous dispersion of alginate, a hydroxyapatite suspension, and a PLA solution in chloroform. The mixtures were dripped into a calcium chloride solution, promoting ionic crosslinking of the alginate and resulting in microparticle formation.

Different polymer ratios were tested to optimise the structural and stability properties of the material. The formulations were evaluated in terms of rheology, morphology, thermal stability, swelling behaviour, dimensional control, and structural integrity. The precursor solutions exhibited pseudoplastic behaviour with an average viscosity of 4.66 Pa•s, enabling controlled extrusion. The most promising formulation, with a PLA/alginate ratio of 1.6, produced spherical microparticles with a homogeneous surface and an average diameter of 0.86 ± 0.040 mm. Swelling tests indicated less than 1% mass variation after 24 hours, confirming dimensional stability. Differential scanning calorimetry (DSC) analysis revealed interactions between the polymers, leading to improved thermal stability. Furthermore, the microparticles maintained their structural integrity for up to 48 hours, demonstrating good physicochemical stability. In conclusion, the hybrid PLA/alginate system containing mesoporous hydroxyapatite exhibited suitable rheological and morphological behaviour for controlled-release applications. The incorporation of hydroxyapatite obtained from tilapia residues not only enhanced the sustainability of the process but also improved the diffusion control of the attractant compounds. This system thus represents a promising national alternative for the environmentally responsible and cost-effective control of Aedes aegypti.

2. “Electrospun Membranes for Tissue Regeneration: Functional Wound Dressings Based on Biopolymers and Bioactive Nanomaterials”

Abstract

Electrospun membranes represent a new generation of functional wound dressings capable of actively promoting tissue regeneration. Unlike traditional dressings, which merely protect the wound, these materials interact dynamically with the wound bed throughout the healing phases, creating a microenvironment conducive to cellular proliferation, angiogenesis, and extracellular matrix (ECM) deposition. The electrospinning technique allows the fabrication of fibrous membranes with controlled porosity, high surface area, and tunable fibre diameters ranging from nanometric to micrometric scales, closely mimicking the architecture of the native ECM. Natural and synthetic polymers such as collagen, gelatin, chitosan, alginate, poly(ε-caprolactone) (PCL), and polylactic acid (PLA) are commonly employed as matrices, owing to their biocompatibility and biodegradability. Incorporating bioactive compounds—including growth factors, antimicrobial agents, or nanoparticles—enhances their therapeutic

performance. Zinc oxide nanoparticles (ZnONPs), for instance, synthesised via green routes, provide intrinsic antibacterial and antiinflammatory activity, reducing the need for systemic antibiotics and mitigating risks associated with bacterial resistance. Electrospun membranes containing 5% ZnONPs have shown inhibition zones up to 24 mm against Staphylococcus aureus, alongside 100% fibroblast viability and a 31% acceleration in cellular migration, evidencing their strong antimicrobial and regenerative potential. Moreover, combining PLA with collagen derived from Oreochromis niloticus (tilapia) has proven highly promising, uniting the mechanical strength of PLA with the bioactivity of collagen. Type I collagen extracted from fish skin exhibited high purity and biocompatibility, reducing fibre diameters from 3.13 µm to 1.24 µm while maintaining porosity around 88%. FTIR spectra confirmed collagen incorporation, and scratch assays demonstrated faster wound closure compared with controls. Altogether, electrospun membranes constitute a versatile platform for the development of biofunctional dressings capable of promoting faster, safer, and more efficient healing. Their tunable composition enables applications ranging from skin repair and burn treatment to bone and cartilage regeneration, establishing them as a promising route toward next-generation biomaterials for tissue engineering and regenerative medicine

Biography

Sabrina Arcaro holds a PhD in Materials Science and Engineering from the Federal University of Santa Catarina, with a research internship at the Institute of Ceramics and Glass (Spain). She completed a postdoctoral fellowship at the Federal University of Rio Grande do Sul and is a CNPq Level 1D Researcher. She serves as Professor and Coordinator of the Graduate Programme in Materials Science and Engineering (PPGCEM) and as Director of Research and Postgraduate Studies at UNESC. She leads the Research Group on Biomaterials and Nanostructured Materials, focusing on bioceramics, glass materials, and the synthesis of nanostructures. With over 140 scientific papers published and six patents filed, she has extensive experience in training master's and doctoral students. She is an editor for national and international journals, a Director of the Brazilian Ceramic Association, and a mentor of the Young Ceramists Network of Brazil. She has received the "Women in Science" and "ALESC Women in Science" awards, recognising her leadership in materials research.

Philip Bresnahan C.R.S
USA

How to Achieve a Disease Free Life with Longevity in view Evidence and Insights

Abstract

Too many people in this country are developing serious health conditions, such as cancer, neurological disorders, and auto-immune diseases, and not understanding how or why this happening to them. Understanding the how and the why is the first step in reversing your health issues naturally. Game-changing, peer-reviewed clinical research unlocks a deeper understanding of the source of disease at the cell level. This will give you the understanding and tools that you will need to reverse your health issues and lead a happier healthy life with longevity in view.

Twenty years ago, I was diagnosed with cancer. I had never really been sick before, so I wanted to find out the how and the why this happened to me. So I became a clinical research analyst for the next 20 years. Through the latest groundbreaking peer-reviewed clinical research that I will share with you, you will learn the common underlining root source of disease and how to address disease at the cell level in order to stop progression of disease in its tracks and possible reverse it altogether.

Learning Objectives:

1. Unlock Game-Changing Research: Gain access to cutting-edge clinical research that will give you a deeper understanding of the source of disease and how to stop it in its tracts.
2. Regenerative Medicine: Discover how natural regenerative medicine can give every cell in your body the energy that it needs to repair itself and help your cells to regenerate new healthy cells again as they were designed to do through mitosis.
3. Knowledge to attain your goals: Complete understanding of the tools that you will

need, to accomplish a disease free life and longevity.
Fields of Science: Functional & Regenerative Medicine, Wellness & Longevity.

Title 2: "Rooted in Science, Driven by Results: Validated Protocols Targeting Disease at the Source" The Future of Clinical Practice

Abstract

Many doctors are working with outdated methods that limit patient care. Yet, the latest clinical research advancements provide the tools to diagnose with precision and treat by targeting the underlying cause of health issues.

In Philips Keynote and Workshop he will bring you up to speed with the latest breakthroughs. This session will simplify your diagnostic process, empowering you to develop personalized, root-cause protocols. The audience will also gain tools to communicate treatment plans effectively, helping patients understand, trust, and feel confident in your approach. With over 20 years of experience as a Clinical Research Analyst Philip Bresnahan is a leading voice in evidence-based, peer-reviewed research. He is dedicated to turning research into actionable protocols that work, equipping physicians to achieve lasting patient outcomes.

Learning Objectives:

1. Unlock Game-Changing Research: Gain access to cutting-edge clinical research that will give you a deeper understanding of the source of your patient's disease.
2. Diagnose with Precision: Discover powerful tools to diagnose more accurately and treat patients with tailored, effective solutions that go beyond the surface.
3. Streamline Your Treatment Approach: Learn how to quickly implement personalized, results-driven protocols that directly target the underlying causes of your patients' health challenges.
4. Build Patient Trust and Confidence: Communicate root causes and treatment protocols clearly, empowering your patients to trust in your expertise and feel confident in their care.

Fields of Science: Functional & Regenerative Medicine.

Jiajing Tang
Radboud University, The Netherlands

Electronic Stimulation in a Dynamic Enhanced System as a Single-input Cue for Regulating Neurovascularized Bone Regeneration

Abstract

To integrate the electrophysiological differences between neural and non-neural cells involved in bone niche and ultimately achieve the goal of neurovascularized bone regeneration, this study proposes a dynamic enhanced stimulation system as an input excitation for bone reconstruction. This is achieved through the implantation of conductive fibrous aniline trimer-based polyurethane (FPAT) membranes in synergy with a non-invasive pulsed electromagnetic field (PEMF). Accordingly, finite element analysis was conducted to predict the electric potential differences, which could elicit a single-input stimulation in the dynamic enhanced therapy, providing a theoretical basis for non-neural cellular regulation and further initiating the rejuvenation of vascular and neural elements on segmental femur defect in mice. Results related to the input of different electric cues demonstrated vascularized bone regeneration emerged with the enhanced stimulation. Concurrently, the dynamical enhanced stimulation system mediated mesenchymal stem cells (MSCs) to express higher levels of calcium ions and neurotransmitters through paracrine. Notably in vivo, the system with higher electric intensity showed good potential for neurovascularized regeneration, promoting the remodeling of bone integrity and achieving bone union comparable to autograft at 8 weeks post-surgery. This non-invasive dynamic system synergistically enhances electrical cues with internal conductive polymers to promote neurovascularized bone regeneration.

Biography

Jiajing Tang finished her Ph.D. in Biomedical Engeering from Sichuan University, China. Following her doctoral studies, she serves as an Assistant Researcher at Guangxi Medical University, China. Currently, she is a visting scholoar at Radboud University in the Netherlands, collaborating on research on antibacterial biomaterials for regenerative medicine. Her research interests include oral and maxillofacial bone repair materials and nano-targeted drug delivery system. She has published in journal such as Chemical Engineering Journal and Acta biomaterialia.

Dr. Marianna T. P. Favaro
Autonomous University of Barcelona, Spain

Sustained release of therapeutics via artificial secretory granules

Abstract

Artificial secretory granules represent a novel class of biomaterials generated through simple engineering steps in which therapeutic proteins self-assemble into amyloid-like depots. These micrometric structures mimic natural amyloids that store and secrete peptide hormones in the endocrine system and are formed via protein interactions coordinated by divalent cations. In addition to enhancing protein stability against degradation, these biomaterials enable the prolonged and tuneable release of therapeutic proteins in nanoparticle form, avoiding the peak-and-valley effect between administrations. The platform has demonstrated therapeutic potential in regenerative medicine, as secretory granules loaded with fibroblast growth factor accelerated wound healing upon local administration. Furthermore, their capacity for prolonged antigen release has been exploited in vaccine development; secretory granules incorporating SARS-CoV-2 antigens produced from diverse expression systems successfully elicited immune responses in animal models, even in the absence of adjuvants. Importantly, artificial secretory granules are biocompatible and non-toxic, with no detectable systemic toxicity following subcutaneous administration. Their modular design tolerates extensive protein sequence modifications, facilitating the incorporation of additional functionalities. Recently, we demonstrated that functionalization with a skin-permeability–enhancing peptide enabled the release of proteins capable of crossing superficial skin layers to reach the hypodermis. Together, these findings position artificial secretory granules as a versatile and safe biomaterial platform for sustained protein delivery with diverse applications.

Biography

Marianna Favaro obtained her PhD in 2017 from the State University of Campinas (Brazil). She subsequently conducted four years of postdoctoral research at the University of São Paulo before joining the Autonomous University of Barcelona (Spain), where she has been a postdoctoral researcher for the past three years in the Nanobiotechnology group. Her work focuses on the design and application of nano- and microparticle-based systems for the delivery of therapeutics and vaccines. She has authored more than 30 publications in the field of nanomedicine.

Dr. Guy Patchornik
Ariel University, Israel

Biomaterials composed of doubly (His)6-tagged proteins

Abstract

We present a simple-to-implement and potentially general method for the preparation of protein-fibers and protein-sheets. Cryo-TEM imaging shows that the approach requires expression of the target protein with two (His)6-tags at its N- and C-termini, followed by its conjugation with Zn2+ (or Ni2+) ions that form a stable complex with at least two (His)6-tags in adjacent protein monomers (by cryo-EM). Protein assembly occurs at neutral pH with no more than an equimolar amount of Zn2+ (or Ni2+) that completely preserves the protein's native state (by circular dichroism). The method was successfully demonstrated with 4 unrelated proteins that differ markedly in their molecular weight and biological role. These are: Ubiquitin 8 KDa, Zdomain of Protein A 13 KDa, fluorescent red protein mCherry 28 KDa, and the CRISPR-associated protein 9 (Cas9) 163 KDa. The simplicity with which (His)6-tags are introduced into proteins, together with their generally non-denaturing nature, implies that a practical mild avenue for the preparation of biomaterials composed of native soluble and perhaps also membrane proteins is now a realistic objective.

Biography

I am an organic chemist who transitioned to biochemistry during my PhD studies at the Weizmann Institute and continued with a postdoctoral position at UCLA. Upon my return to Isreal I joind the chemistry dept. at Atiel univeristy where we focused on the development of a method for crystallization of membrane proteins and antibdy pufification. Thus far, we published >33 papers.

Dr. Conrado Ramos Moreira Afonso
Universidade Federal de São Carlos, Brazil

Advanced Processing trhough Acumulative Roll Bonding and 3D printing of Multiprincipal Beta Ti-Nb-Zr alloy for Implants

Abstract

β-Ti alloys are considered for biomedical applications due to their mechanical properties, good biocompatibility and corrosion resistance. Therefore, Ti and its combinations have been applied as biomedical implants, such as the Ti-6Al-4V combination. However, it presents problems regarding the cytotoxicity of Al and V elements related to neuronal disruption and Alzheimer's disease, even with good mechanical properties. The present study aims to evaluate the feasibility of producing trhough advanced processing by laser 3D printing (LPBF) and Acumulative Roll Bonding (ARB) of BCC multiprincipal β-Ti (Ti-33Nb-33Zr). The objective was to define which thermomechanical processing parameters (degree of deformation per pass, intermediate annealing temperature and number of ARB cycles) would produce satisfactory, well-adhered joints with few or no voids/defects. The main results indicated that it is feasible to produce such heterostructured sheets with up to 7X ARB cycles, which were preheated for 5 min at 500 °C. The tests performed at 300 °C indicated that there was not enough adhesion between the layers. Even at 500 °C, the results suggested that an extra pass at the end of the last ARB cycle could increase the adhesion of the last created interface. Results showed increasing of Vickers microhardness of Ti-α (from 212 to 290 HV) and β Ti-33Nb-33Zr (from 231 to 303 HV) before deformation and after 7 passes of ARB. Regarding elastic modulus, pure materials showed Ti-α (E = 100 GPa) and β Ti-33Nb-33Zr (E = 68 GPa) previously to the deformation, after 4 and 7 passes of ARB the heterostructure showed E = 74 GPa and 66 GPa, respectively, confirming a reduction of nanostructured Ti-α/βTi-33Nb-33Zr in-situ deformed heterostructure. 3D printing of multiprincipal β Ti-33Nb-33Zr alloy formed a refined stable β-Ti microstructure

with microhardness of 310 HV and low elastic modulus of (E = 62 GPa) suitable for applicaiton as biomedical implantes avoiding stress shielding.

Biography

Finished his PhD at 27 years old years in Materials Science from Universidade Federal de São Carlos (UFSCar) and postdoctoral investigations from Mechanical School of State University of Campinas (UNICAMP) and Universidad Politecnica de Valencia (UPV). He was the head of Materials Engineering Department (DEMa/UFSCar) from 2022 - 2024. He has experience of 25 years in electron microscopy (TEM) and published more than 170 papers in high standard journals in Materials Science and Engineering.

Dr. Mehdi Mehdizadeh
Iran University of Medical Sciences, Iran

Angiogenic lipid-based drug delivery system (PhytoSolve) for treatment of a thin endometrium in animal model

Abstract

Impaired vascular growth resulting from reduced vascular endothelial growth factor (VEGF) in the epithelial tissue of the glands is a primary cause of thin endometrium. Inducing angiogenesis offers a possible therapeutic strategy for this condition. This study aimed to develop a novel drug delivery system using S75 lipoid loaded with VEGF for thin endometrium therapy. The formulation of PhytoSolve consisted of a combination of lipid S75, glycerol, and MCT oil, which was prepared utilizing a probe sonicator. Female NMRI mice (n=30) were divided into six groups: control, sham, thin endometrial model, VEGF treatment, PhytoSolve treatment, and VEGF/PhytoSolve treatment. A thin endometrial model was induced by injecting 95 % ethanol. After the treatment period, tissue samples were collected to assess the endometrial thickness—the mean particle size of the PhytoSolve formulation measured 67.57±7.07 nm. Approximately 40 % of the loaded VEGF was released within the first 24 hours, followed by a sustained release rate of 10–20 % daily. The PhytoSolve group containing VEGF exhibited significantly increased endometrial thickness compared to the VEGF group ($P<0.05$). S75 lipoid-based PhytoSolve loaded with VEGF effectively promoted blood vessel formation. The combination of PhytoSolve S75 and VEGF holds promise for developing a biocompatible drug delivery system with therapeutic potential for treating thin endometrium and various other biomedical applications.

Biography

Mehdi Mehdizadeh, Ph.D., is a specialist in Anatomical Sciences and a Fellow in Transgenic Animals at the Reproductive Science and Technology Research Center, Iran University of Medical Sciences, Tehran, Iran. His research focuses on regenerative medicine, reproductive biology, neurodegenerative diseases—particularly Alzheimer's disease—and nanotechnology-based drug delivery systems. Dr. Mehdizadeh has contributed to multiple peer-reviewed publications and international conferences. His interdisciplinary work aims to develop novel therapeutic strategies for treating infertility, neurodegenerative disorders, and tissue regeneration impairments.

Dr. AKON-LABA Akalé Bernadette
School of Dentistry, UP Biomaterials, Ivory Cost

Effect Of A Clay Material On Alveolar Bone Healing In Wistar Rats

Abstract

The purpose was to analyze the effects of Anyama green clay (AVA) on bone healing in Wistar rats.

Methods:
This study included 36 Wistar rats aged 10 months. Bone defects of 14 mm were created in the alveolar bone at the level of the upper post-incisor diastema. 100 mg of AVA, at different pH in dry or paste form, were inserted into these defects. The study groups are: Control Groups, males (MT) and females (FT) that received no treatment. For the other groups, the bone wound was treated with: • AVA in paste form at neutral pH in males (MPN) and females (FPN), at acidic pH in males (MPA) and females (FPA), at basic pH in males (MPB) and females (FPB), • AVA in dry form at neutral pH in males (MSN) and females (FSN), at acidic pH in males (MSA) and females (FSA), at basic pH in males (MSB) and females (FSB). The animals were sacrificed after 15 days (D15) and bone samples were collected for histological study using staining (HE and TM). Pearson's Chi-squared test was used to assess correlations between the amount of healing tissue and the pH of AVA.

Results
- AVA improved the healing process: abundance of fibrous tissue at the bone wound sites in treated rats compared to controls. Except for the acidic pH - A predominance of healing tissue was observed in 75% of rats treated with basic AVA compared to other pH levels and controls. However, there was no association between clay pH and

the presence of fibrous tissue on D15 (p-value = 0.1411 (Tab.1)).
Conclusion: Within the limits of this study, AVA could be considered as a biomaterial that may promote bone healing.

Biography

She is a professor of biomaterials at FHB University in Abidjan (Côte d'Ivoire). She studied at Paul Sabatier University in Toulouse (France). She is a member of scientific societies in biomaterials and has published several articles on biomaterials.

Dr. Feray Bakan Misirlioglu
SUNUM Sabanci University, Turkey

Covalent Conjugation of Quercetin to Oxidized β-Cyclodextrin via Acid-Catalyzed Condensation: A Two-Step Strategy for Enhanced Solubility and Antioxidant Activity

Abstract

Quercetin is a widely distributed natural flavonoid with strong antioxidant, anti-inflammatory, and antimicrobial activities; however, its practical use remains limited by poor aqueous solubility and low bioavailability. To overcome these limitations, numerous studies have focused on conjugating quercetin to polysaccharides, yielding functional biopolymers with enhanced biological properties. Cyclodextrins (CDs), cyclic oligosaccharides with a hydrophobic cavity and hydrophilic exterior, offer superior solubilization capacity compared to conventional polysaccharides and are widely used in drug delivery. Nevertheless, CD-based inclusion complexes may suffer from instability, resulting in premature drug release. Covalent conjugation provides a more stable alternative by eliminating dissociation concerns while permanently improving solubility.

In this study, quercetin was conjugated to oxidized β-cyclodextrin (β-CD) through a two-step acid-catalyzed condensation reaction. β-CD was first oxidized using sodium periodate to generate dialdehyde groups. Subsequently, quercetin was covalently attached to the oxidized β-CD under acidic conditions, forming a stable β-CD–quercetin conjugate. This synthetic route offers several advantages, including mild reaction conditions, simplicity, cost-effectiveness, and the absence of specialized instrumentation. Although quercetin conjugation to other polysaccharides such as starch and chitosan has been reported, no previous study has utilized oxidized β-CD for this purpose.

The successful conjugation was confirmed through structural and spectroscopic analyses, and the antioxidant capacity of the conjugate was evaluated. The results demonstrate that covalent attachment of quercetin to oxidized β-CD significantly enhances its aqueous solubility and maintains or improves its antioxidant performance. This work introduces a promising and stable alternative to inclusion complexation for the development of quercetin-based functional materials and drug delivery systems.

Biography

Dr. Feray Bakan Misirlioglu is a materials scientist and whose research focuses on biomaterials, nanocharaterization techniques and the physicochemical characterization of functional biomaterials. She has contributed to interdisciplinary studies in nanomedicine, drug delivery, and manuscript conservation, with expertise in calcium phosphate nanoparticles, encapsulation systems, and historical pigment characterization. Dr. Mısırlıoğlu has authored more than 50 peer-reviewed journal articles, book chapters, and conference proceedings, and has contributed to patented developments in materials science and nanotechnology. She has served on scientific and organizational committees of the Turkish Electron Microscopy Society, supporting national scientific programs, seminar series, and congress activities.

Melissa A. Grunlan
Texas A&M University, USA

A Resurfacing-Regenerative Approach to Repair Osteochondral Defects

Abstract

Osteochondral defects (OCDs), areas of localized joint damage to articular cartilage and underlying subchondral bone, often lead to pain, loss of joint function, and osteoarthritis. Clinical repair is focused on biological grafting procedures, which are innately limited by graft availability and donor site morbidity. We have developed a bioprosthetic implant, combining articular cartilage resurfacing and osseous tissue regeneration, as a new method for OCD repair. These implants – “cartilage-capped, regenerative osteochondral plugs (CC-ROPs)” - combine a multi-network hydrogel (cartilage cap) and osseous scaffold (base). The cartilage cap is prepared from a multi-network, electrostatic hydrogel that gives rise to articular cartilage-like mechanical, hydration, and tribological properties. The osseous scaffold base is prepared from a semi-interpenetrating polymer network (semi-IPN) of poly(ε-caprolactone)-diacrylate (PCL-DA) and poly(L-lactic acid) (PLLA). The scaffold is intrinsically osteoinductive and has a trabecular bone-like modulus as well as robust degradation rates to facilitate bone ingrowth. Formed as cylindrical plugs, CC-ROPs may be implanted into OCDs using existing grafting techniques and be fabricated in a range of sizes. In vitro and in vivo performance of the cartilage cap, osseous scaffold, and CC-ROP device demonstrate encouraging results towards development of an alternative OCD treatment.

Biography

Melissa Grunlan is a Professor of Biomedical Engineering at Texas A&M University (TAMU) and Holder of the Charles H. and Bettye Barclay Professorship in Engineering. She is also a TAMU Chancellor EDGES Fellow and Presidential Impact Fellow. She holds courtesy appointments in the Department of Materials Science & Engineering and the Department of Chemistry. Her work is focused on the development of synthetic polymeric biomaterials for implanted medical devices and for regenerative engineering. She is a Fellow of the American Institute for Medical and Biological Engineering (AIMBE), the American Chemical Society (ACS), the ACS PMSE Division, and the Biomedical Engineering Society (BMES). Prof. Grunlan is also a Senior Member of the National Academy of Inventors.

Dr. Vineetha Jayawarna
University of Glasgow, Glasgow, United Kingdom

Engineering Bioactive Monetite Scaffolds to Enhance Stem Cell Osteogenesis and Bone Healing

Abstract

Repairing large bone defects remains a major clinical challenge as the use of autografts is limited by availability and donor-site complications. Therefore, the development of synthetic bone graft substitutes that can effectively support new bone formation and integrate with host tissue is of great importance. Monetite ($CaHPO_4$) is a biodegradable calcium phosphate ceramic with excellent remodelling characteristics, providing a suitable environment for bone regeneration. In this study, we functionalised monetite scaffolds with a nanometre-thick coating of poly(ethyl acrylate) (PEA)[1], designed to organise fibronectin (FN) into a bioactive network capable of efficiently presenting bone morphogenetic protein-2 (BMP-2) to cells. In vitro experiments using human mesenchymal stem cells confirmed that PEA + FN + BMP-2 coatings markedly enhanced cell attachment, proliferation, osteogenic gene expression, and mineral deposition compared with uncoated monetite. To advance clinical translation, platelet-rich plasma (PRP) was evaluated as a substitute for FN and produced comparable osteogenic outcomes. In vivo evaluation in a rat femoral critical-size defect model confirmed that PEA-coated monetite implants supported new bone formation and vascularisation. Large animal studies in sheep are currently ongoing to further assess translational performance. Overall, these findings highlight the potential of PEA-functionalised monetite scaffolds as a versatile platform for bone regeneration using reduced doses of growth factors.

[1] Cheng, Z.A., et al., 2019, Adv.Sci., 6, 1800361.

Biography

Vineetha Jayawarna is a Senior Microscopy Technician at the Centre for the Cellular Microenvironment (CeMi), University of Glasgow, where she leads the newly established Mechanobiology Facility. She completed her Ph.D. in biomaterials at the University of Manchester and held postdoctoral positions at the University of Strathclyde and the University of Glasgow. In her current role, Vineetha provides advanced microscopy expertise and contributes to collaborative research projects focused on material-based strategies for tissue repair and regeneration, including the development of bioactive scaffolds for bone regeneration. She has extensive experience in biomaterials, cell culture, and advanced imaging techniques, supporting the translation of innovative material systems towards clinically relevant bone regenerative therapies.

Dr. Roopa Chalasani
Wake Forest University School of Medicine, USA

Development of a Chorioallantoic Membrane (CAM)-Based Angiogenesis Platform for Enhancing Neovascularization in Renal Organoid Constructs

Abstract

Achieving robust vascularization is essential for the survival, growth, and functional integration of organoids in regenerative medicine. Human renal organoids, derived from renal progenitor or pluripotent stem cells, can selforganize into nephron-like structures and demonstrate aspects of kidney development in vitro. However, the absence of functional vasculature restricts their maturation and longevity.

The chorioallantoic membrane (CAM) model of the developing chick embryo provides a highly vascularized, immunodeficient, and biologically relevant in vivo platform. This platform supports direct host–construct interaction, real-time visualization of angiogenesis, and rapid vascular remodeling without immune rejection.

The CAM model, which is cost-effective, ethically favorable, and compliant with the 3Rs principles (Replacement, Reduction, Refinement), makes it an ideal intermediate between in vitro culture and mammalian preclinical models. Leveraging these advantages, this study investigated a novel approach to promoting vascularization of human renal organoids using the CAM model. We hypothesized that supplementation with vascular endothelial growth factor (VEGF) and co-culture with endothelial cells (ECs) would enhance angiogenesis, vessel infiltration, and organoid structural preservation compared to the organoid-only group.

Human renal organoids were embedded within fibrin scaffolds (250 μL, 10 mg/mL) prepared from a stock solution containing 40 mg/mL fibrinogen, 3 U/mL thrombin, and

40 μg/mL aprotinin. Each scaffold in the VEGF-treated groups was supplemented with 100 ng/scaffold of VEGF. Scaffolds were implanted on the chorioallantoic membrane (CAM) of chick embryos on embryonic stage day 6, precisely positioned at the intersection of mature blood vessels to maximize host vascular interaction. Three experimental groups were established: (1) organoids-only, (2) organoids with VEGF, and (3) organoids with VEGF plus endothelial cells (5M cells, MS1). Constructs were harvested on day 10 post-implantation and analyzed using gross imaging, histology (H&E), and immunofluorescence staining (AQP-1, VWF, LTL, HLA) to evaluate vascular infiltration, organoid structure, and host–implant interactions. Lectin staining was performed to assess vessel morphology within the scaffold. Vessel and branch counts were quantified, and organoid size dynamics were compared. Statistical significance was determined using the Kruskal-Wallis test.

We demonstrated that the VEGF supplementation significantly enhanced angiogenesis, endothelial recruitment, and vessel branching compared to the organoid-only group. The VEGF + MS1 group demonstrated the most favorable outcomes, characterized by larger organoid size, enhanced structural integrity, and robust integration with CAM vasculature, with clear evidence of vessel penetration into the fibrin scaffold. The organoid + VEGF group also maintained the structural integrity of organoids and showed moderate vascularization, although vessel infiltration into the fibrin scaffold was less pronounced compared to the MS1 condition. In contrast, Organoid-only scaffolds remained smaller and exhibited poor survival despite hypoxia-induced angiogenesis. Statistical analysis of the organoid size revealed significant differences among groups ($p = 0.016$) and significant temporal changes in vitro ($p = 0.00044$). Immunofluorescence staining confirmed the presence of endothelial, stromal activation, and preservation of organoidspecific markers.

The CAM assay, which is a powerful, ethically favorable, and cost-effective in vivo platform, offered vascularization and integration of human renal organoids. VEGF plays a crucial role in stimulating angiogenesis and maintaining organoid structure. Notably, Co-existing with endothelial cells facilitated superior vessel–organoid integration and organoid survival. These findings suggest that fibrin scaffolds supplemented with VEGF and endothelial cells provide a promising strategy for generating pre-vascularized renal constructs, advancing their potential applications in regenerative medicine.

Biography

Dr Roopa Chalasani is a medical graduate from Vydehi Institute of Medical Sciences and Research Centre, Bangalore, India, and currently serves as a Visiting Scholar at the Wake Forest Institute for Regenerative Medicine (WFIRM), USA, where she is pursuing a three-year research fellowship in tissue engineering and biomanufacturing.

She is the author of Urology 7.0, a forward-looking scholarly work examining the integration of artificial intelligence, robotics, digital surgery platforms, and ethical frameworks into contemporary urologic practice. The book explores emerging technologies such as peripheral neurostimulation for urinary incontinence, robotic reconstructive techniques, minimally invasive therapies for benign prostatic hyperplasia, sustainable surgical innovation, and digital ethics in surgical care.

In addition to her book, Dr. Chalasani has published peer-reviewed review articles and serves as a peer reviewer for clinical and biomedical research journals. Her academic interests center on regenerative medicine, translational science, and the ethical implementation of next-generation surgical technologies.

Dr. Tomasz Gredes
Technische Universität Dresden, Germany

Comparative evaluation of strategies for incorporating BMP-2 with regard to the osteoinductive potential of PLLA scaffolds for guided bone regeneration

Abstract

Membranes applied in oral regeneration have proved to be essential in regenerative procedures, increasing the quality, volume, and stability of the regenerated tissues. They can prevent in-growth of soft tissue to the bone defect, and creating an underlying space to support bone growth. Additional components of such barrier membranes can reduce inflammatory processes in the surrounding tissue and increase bone regeneration.

Bone morphogenetic protein-2 (BMP-2) is a growth factor directly involved in the differentiation and maturation of bone cells. Its incorporation into scaffolds represents a promising strategy in bone tissue engineering.
The objectives of this study were: to incorporate BMP-2 into electrospun poly-L-lactide (PLLA) membranes using two distinct techniques, electrospinning of a co-solution or the layer-by-layer (LBL) assembly method; and to evaluate in vitro the osteogenic differentiation potential of these biomaterials. In the electrospinning approach, BMP-2 was incorporated into PLLA meshes by electrospinning a co-solution containing 5% PLLA and 2.5 μg/mL BMP-2 in a chloroform/dimethylformamide mixture. In the LBL approach, BMP-2 was immobilized onto electrospun PLLA fibers through sequential deposition of heparin/BMP-2 layers alternated with chitosan layers, generating constructs with either 4 or 10 layers in total. The membranes were characterized by scanning electron microscopy (SEM), and BMP-2 release was quantified by ELISA

a long 21 days. Human periodontal ligament stem cells (hPDLSCs) were cultured on the membranes. The osteogenic differentiation was evaluated by quantitative PCR (qPCR) for osteogenic markers after 7 and 21 days of culture, respectively.

BMP-2 release profiles demonstrated that both incorporation strategies were effective, though they exhibited distinct release dynamics. Moreover, the 10-layer LBL membranes increased expression of osteopontin (OPN), and reduced expression of RUNX2 from 7 to 21 days compared with the other groups. In conclusion, incorporation of BMP-2 into PLLA electrospun meshes using the 10-layer LBL assembly was effective in enhancing the osteogenic differentiation of hPDLSCs.

Dr. Amina Al Dababsekh
Kriukivshchyna, Kyivs'ka oblast, Ukraine

Cord Blood-Derived Mesenchymal Stem Cells in the Management of Autism Spectrum Disorder

Abstract

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition marked by deficits in social interaction and communication, along with restricted and repetitive behaviors. Current treatment strategies primarily focus on behavioral and supportive therapies and do not address underlying biological mechanisms. Emerging evidence suggests that immune dysregulation and neuroinflammation may contribute to ASD pathophysiology, making regenerative and immunomodulatory therapies a potential area of interest. This study evaluated the safety and potential efficacy of umbilical cord blood–derived mesenchymal stem cells (UC-MSCs) in children with ASD.

This single-arm Phase I/II clinical trial included 27 children aged 2.5 to 12 years diagnosed with ASD according to DSM-5 criteria. Participants received four subcutaneous injections of UC-MSCs at three-month intervals, administered in the periumbilical region at a dose of 2 million cells per kilogram per injection. Stem cells were obtained from screened umbilical cord donors and processed under Good Manufacturing Practice (GMP) conditions. Clinical and laboratory assessments were conducted at baseline, 3, 6, and 12 months post-treatment, with a final follow-up at 21 months. Safety outcomes included monitoring for adverse events, routine laboratory testing, and measurement of inflammatory markers (MDC and TARC). Efficacy was evaluated using standardized autism-specific scales (CARS, ATEC, ADOS), cognitive assessments, behavioral scales, and quality-of-life measures. Statistical analysis assessed changes over time using repeated-measures methods.

UC-MSC therapy demonstrated a favorable safety profile, with no severe treatment-related adverse events. Reported adverse effects were mild and transient, primarily consisting of localized injection-site reactions and temporary behavioral changes. Clinically meaningful improvements were observed in autism severity scores, with significant reductions in CARS and ATEC scores at 12 months. Forty-one percent of participants demonstrated sustained improvement sufficient to shift into a lower diagnostic severity category. Decreases in inflammatory markers paralleled clinical improvements, suggesting a possible immunomodulatory effect.
In conclusion, UC-MSC therapy appears to be safe and shows potential benefit in reducing ASD symptom severity. These findings warrant further investigation through larger, randomized controlled trials to establish efficacy and long-term outcomes.

Keywords
Autism Spectrum Disorder, Cord Blood-Derived Stem Cells, Mesenchymal Stem Cells, Neuroinflammation, Pediatric Therapy.

Biography

Dr Amina Al Dababsekh, MBBS, is a physician with international clinical and academic training and a focused interest in women's health and regenerative medicine. She graduated from Gulf Medical University, Ajman, United Arab Emirates, and completed her medical internship (2024- 2025) at King's College Hospital Dubai. Dr. Amina is currently an Obstetrics and Gynecology resident at the Governmental OBGYN Hospital and Birthing House No. 3 in Kyiv, Ukraine, while also serving as Medical Director at ID Clinic.

Alongside her clinical training, she has completed multiple certified courses and international electives, including Basic Life Support, Basic Surgical Skills, Basic Orthopedic Skills, and emergency medicine and general surgery rotations. She also participated in the Cyberpatient Summer School Program, ranking among the top 100 participants globally. Her academic interests include stem cell–based therapies for premature ovarian failure, stem cell–derived spermatogenesis, and neuroregeneration in autism spectrum disorders. Dr. Amina has authored peer-reviewed research and regularly presents at regenerative medicine conferences.

Shivam Otavi
National Institute of Pharmaceutical Education and Research (NIPER), India

Laser-Activable Nanoparticle-Infused Gel for hard-to-heal Diabetic Wound

Abstract

Near-infrared (NIR) laser-assisted photobiomodulation therapy has attracted increasing interest as a non-invasive modality for modulating cellular and molecular pathways in diabetic wound healing by augmentation of angiogenesis and tissue regeneration. This investigation reports the fabrication and application of NIR-laser-activable biogenic silver nanoparticles (BNPs) as potent enhancers of photobiomodulatory effects within diabetic wounds. Comprehensive characterization Biosynthesized BNPs were evaluated using dynamic light scattering (DLS), transmission electron microscopy (TEM), powder X-ray diffraction (pXRD), inductively coupled plasma mass spectrometry (ICP-MS) and energy-dispersive X-ray spectroscopy (EDX). The physicochemical characterization of the BNPs exhibited efficient photothermal conversion efficiency upon NIR-laser irradiation. The biological activity, evaluated in vitro using HaCaT keratinocyte cells in scratch assays, showed improved cellular migration, particularly with NIR exposure. Pre-clinical evaluation of a composite system comprising BNPs embedded in a biocompatible gel was performed in a fullthickness diabetic mouse wound model. The gel maintains a hydrated wound environment while enabling sustained, localized delivery of BNPs. This synergistic approach resulted in significantly enhanced wound contraction and tissue regeneration. Histological and immunohistochemical analysis confirmed enhanced neovascularization, granulation tissue deposition, and reepithelization. Gene expression profiling revealed upregulation of pro-regenerative markers, notably CD31, VEGF, α-SMA, and β-catenin. These results highlight a promising integrated approach for treating chronic diabetic wounds using NIR laser-activated nanotherapy within a biocompatible gel matrix.

Keywords: Biomaterials, Nanoparticles, NIR-Responsive, Diabetic wound healing .

Biography

Shivam Otavi, pursuing a Ph.D. in Department of Pharmaceutics at the National Institute of Pharmaceutical Education and Research, Ahmedabad (NIPER-A), under the distinguished mentorship of Professor Rakesh Kumar Tekade. He is dedicated to advancing innovative therapeutic strategies for wound healing and inflammatory disorders. His research focus centers on the development of metallic formulation approaches that address the multifaceted challenges associated with chronic wounds, drawing from interdisciplinary principles of pharmaceutics, biomaterials, and regenerative medicine. He is committed to contributing meaningful advancements to the fields of wound management and inflammation therapeutics. Recently, he was awarded the Best Oral Presentation at International Conference on Mesoscience 2025, Kangra, India.

A. Aslihan GOKALTUN
Harvard Medical School, Massachusetts General Hospital, USA

Mechanically Robust Gentamicin-Linked Hybrid Hydrogels: Prolonged Infection Control in Burn Care

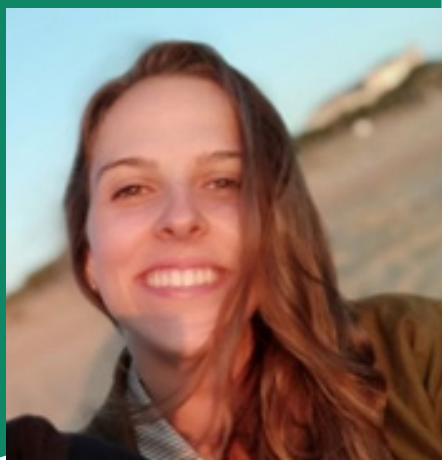
Abstract

Burn wound infections, primarily caused by Staphylococcus aureus and Pseudomonas aeruginosa, remain a major clinical challenge, delaying healing and increasing the risk of mortality. Gentamicin sulfate (GEN) is a potent broad-spectrum antibiotic, widely used for infection control. However, conventional GEN-loaded hydrogels often suffer from burst release and inadequate mechanical strength for sustained wound coverage. Here, we report GEN-loaded (0.11-0.72 w/v%) supramolecular hybrid hydrogels (GEN-SHHs) in which GEN plays a dual role as both a potent antimicrobial and a dynamic physical crosslinker. GEN assembles with cucurbit[7]uril host-guest motifs and clay nanosheets via electrostatic interaction to form an interpenetrating polymer network that gels ultrafast (within 5 seconds) and achieves an exceptional elastic modulus (~250 kPa) -the highest reported for cucurbituril-based or antibiotic-crosslinked hydrogels. This integrated design achieves sustained GEN release for 14 days while maintaining high biocompatibility (>95% viability) in human dermal fibroblasts and epidermal keratinocytes. GEN-SHH maintains antibacterial concentrations above the minimum inhibitory and bactericidal concentration thresholds for S. aureus and P. aeruginosa, achieving complete eradication (>99.999%) at GEN loadings ≥8 mg for at least 3 days. These results establish GEN-SHH as a robust, multifunctional hydrogel platform that unites mechanical reinforcement and potent antimicrobial efficacy for advanced infection-resistant wound healing.

Biography

A. Aslihan Gokaltun, PhD, is a faculty member at Harvard Medical School and Massachusetts General Hospital (MGH), with an appointment in the Center for Engineering in Medicine and Surgery. Her research focuses on engineering next-generation biomaterials and preservation strategies to improve wound healing, therapeutic delivery, and tissue viability. Bridging preclinical innovation and clinical translation, her work addresses critical unmet needs in surgery, trauma, chronic wound care and cell-based therapies across diverse patient populations.

Dr. Gokaltun is an inventor on multiple patents and has published in high-impact journals spanning biomaterials, bioengineering, and separation science. She has secured competitive funding from the National Institutes of Health, Shriners Children's Boston, and MGH internal programs to support translational research in smart biomaterials. Her achievements have been recognized with numerous honors, including the Aziz Sancar Postdoctoral Fellowship and first-place awards in the Stephen and Geraldine Ricci Interdisciplinary Prize and Tufts University's $100K New Venture Competition. Her research has been widely featured in national and international media.



Jeanne Minvielle Moncla

University of Toulouse, Laboratoire d'analyse et d'architecture des systèmes, RESTORE, a geroscience and rejevunation center – Toulouse, France

Engineering a regenerative mesenchyme for age-related diseases therapy : example of periodontitis

Abstract

Increased life expectancy is accompanied by a higher incidence of age-related diseases (ARD), characterized by multi-tissue dysfunction and progressive decline in quality of life. Given their broad trophic activity and central role in tissue repair, mesenchymal stromal cell (MSC) therapies represent a promising strategy for the management of ARD-associated lesions. Preclinical studies from our laboratory provided encouraging evidence that a fibrin hydrogel containing dispersed ASC, developed as an Advanced Therapy Medicinal Product (ATMP), is effective when grafted for the treatment of canine periodontitis —an age-related and disabling oral disease affecting tooth-supporting tissues. Nevertheless, outcomes displayed inter-individual variability with incomplete regeneration. Thus, to improve ARD lesion cell therapy, ATMP graft have to provide primed MSC organized in a more adequate 3D microenvironment than fibrin hydrogels. In this context, we are developing a tissue engineering strategy to provide essential biomechanical support for MSCs toward a regenerative phenotype. For this purpose, we developed a cylindrical shape called “cylindroid”, an MSC-supporting hydrogel enabling investigations of cell-matrix interactions critical in tissue repair, by multi-modal and multi-temporal approaches. First, iterative back-and-forth reverse engineering progressively highlighted the optimal carrier biomaterial architectural parameters to enhance the post-implantation tissue response. During in vitro cylindroid culture, MSCs pull and remodel the material over time according to hydrogel rigidity and micro-architecture, impacting pre-grafting cell behaviour. Implantation of this ATMP in our relevant aging mouse model of periodontitis demonstrated adequate initial bio integration and safety while implanted MSCs survival depend on hydrogel

composition and culture duration before implantation. Moreover, preliminary efficacy experiment suggest a better long-term gingival repair with ATMP MSC-cylindroid, compared to hydrogel alone.

Biography

Formerly Consultant Breast Surgeon at Imperial College Healthcare Trust (at Charing I hold a Master's degree in Paul Sabatier University and I am currently pursuing a PhD within the Toulouse University, GOT-IT Team (Restore Institute), and EliA Team (LAAS-CNRS). My tissue engineering project is built on a multidisciplinary approach, which I believe is essential to addressing tomorrow's scientific challenges. I have had the opportunity to present my work at a summer school (poster), a national conference (oral communication), as well as through an oral presentation at the scientific days of lab Restore, where I also contributed to the organization. In addition, I am co-author of a recently published article in collaboration with LAAS : Aigoin J, et al. Comparative Analysis of Electron Microscopy Techniques for Hydrogel Microarchitecture Characterization:

SEM, Cryo-SEM, ESEM, and TEM. ACS Omega. 2025 Apr 14;10(15):14687-14698.

Amin Orash Mahmoudsalehi
School of Engineering and Science, Tecnologico de Monterrey, Monterrey, Mexico

Transparent Sodium Alginate/Polyvinyl Alcohol Hybrid Casting Films for Corneal Stromal Regeneration

Abstract

Developing a transparent substitute that mimics the mechanical and optical properties of the cornea while supporting favorable cell–scaffold interactions remains a major challenge in corneal stromal regeneration (CSR). In this study, we engineered transparent, thin hybrid casting films (HCFs) by blending sodium alginate (SA) with polyvinyl alcohol (PVA) using the solvent casting method. The fabricated HCFs were systematically evaluated for their physicochemical, mechanical, and biological characteristics, including transparency, tensile strength, water uptake, gel fraction, degradation, and cytocompatibility. The optimized films exhibited a high optical transparency of ~91%, enhanced water absorption (~353%), and strong structural stability with a gel fraction of ~90%. Mechanical testing demonstrated favorable tensile properties (UTS ~15 MPa; elongation at break ~9%). In vitro assays confirmed the films' biocompatibility and potential to support cell– material interactions. These findings suggest that SA/PVA hybrid films represent a promising platform for CSR applications, warranting further in vitro and in vivo investigation.

Biography

Amin Orash Mahmoudsalehi is a PhD candidate in Nanotechnology at Tecnológico de Monterrey, Mexico, working in the laboratory of Dr. Wendy de Lourdes Ortega-Lara. His doctoral research focuses on corneal tissue engineering and regenerative medicine, with particular emphasis on developing biomaterial scaffolds for corneal stromal regeneration. He earned his MSc in Biomedical Engineering and has been

awarded multiple competitive grants and fully funded scholarships. His expertise spans biomaterials, electrospinning, solvent casting, scaffold fabrication, and advanced material characterization. Amin has published several peer-reviewed articles, with more than 650 citations and an h-index of 11. In addition to his research, he serves as a reviewer and editorial board member for international journals and has collaborated on national and international projects. His work aims to advance translational strategies for ophthalmic applications and innovative biomaterial-based therapies.

YuChieh Wu
Institute of Physiology of the Czech Academy of Sciences, The Czech Republic

Pre-Vascularized Collagen Hydrogels as a Platform for Regenerative Tissue Models

Abstract

Animal models have long been employed in biomedical research, yet their use is increasingly limited by ethical concerns, high costs, and poor translational relevance to human diseases. Recent advances in stem cell biology, biomaterials, and tissue engineering have enabled the development of three-dimensional (3D) in vitro tissue models as promising alternatives. A critical challenge in these systems is the integration of vascularized networks to replicate physiological microenvironments and provide predictive insights for drug testing, toxicology, and disease modeling.

In this study, we aimed to construct vascularized 3D hydrogels with multicellular components and to optimize culture strategies for their application in skin, blood vessel wall, and bone models. Adipose-derived stem cells (ASCs) and human umbilical vein endothelial cells (HUVECs) were cocultured using various approaches. The most robust capillary-like networks were obtained when ASCs were first seeded on nanofibrous membranes and subsequently migrated into collagen hydrogels with HUVECs. Building upon this vascularized platform, one-layer and two-layer skin models were successfully generated by seeding keratinocytes onto the pre-vascularized constructs, with the two-layer system enabling comparison between normal and pathological skin states. For vascular wall models, pre-vascularized hydrogels treated with TGF-β1 and BMP4 promoted ASC differentiation into smooth muscle cells, evidenced by calponin expression, though vascular structures became disrupted after 21 days of culture. Similarly, bone constructs supplemented with osteogenic factors showed incomplete ASC differentiation and loss of pre-vascularization after 28 days of culture.

In conclusion, ASC-HUVEC co-culture within collagen hydrogels successfully reduced

matrix contraction and supported the formation of dense vascular networks. While stable vascularization was achieved in skin models, integration with blood vessel wall and bone differentiation protocols remains challenging due to the inherent competition between vascular stability and lineage-specific maturation.

Biography

M.Sc. Yu-Chieh studied for her master's degree at the Institute of Biochemical and Biomedical Engineering in Taiwan and finished in 2013. She started her PhD degree in 2022 in the Czech Republic in the Department of Biomaterials and Tissue Engineering, Institute of Physiology, Czech Academy of Science.

Degu Melaku Kumelachew
Bahir Dar University, Ethiopia

Advanced Materials and Digital Strategies in 3D Bioprinting: Breakthroughs in Multimaterial Fabrication, Embedded Bioinks, and AI-Driven Clinical Translation

Abstract

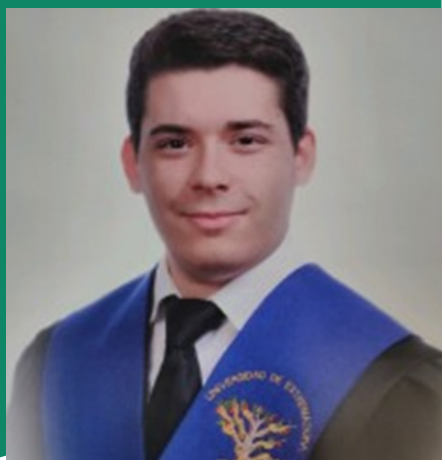
Three-dimensional (3D) bioprinting has rapidly emerged as a transformative technology in regenerative medicine, enabling the precise fabrication of living tissue constructs with complex architectures and tailored functionalities. Recent advances in bioink development, including sophisticated composite formulations and nanomaterial integration, have significantly improved printability, biocompatibility, and functional mimicry of native tissues. Concurrently, innovative fabrication strategies such as embedded, volumetric, and light-based bioprinting facilitate the construction of multi-material, vascularized, and patient-specific tissue models that address critical challenges in scale and complexity. The integration of artificial intelligence and machine learning enhances design optimization, real-time process control, and quality assurance, accelerating the translation of bioprinting from laboratory proof-of-concept to clinical applications. Notable progress in clinical translation includes patient-specific grafts for bone, cartilage, skin, and vascular tissues advancing into early trials, alongside functional tissue analogs for drug screening and disease modeling. Despite ongoing challenges in fabricating fully vascularized, innervated, and mature bulk organs, the convergence of advanced materials, digital strategies, and interdisciplinary collaboration positions 3D bioprinting as a revolutionary platform set to redefine personalized regenerative therapies and precision medicine.

Biography

Degu Melaku Kumelachew is a PhD candidate in Textile Materials and Materials Design at Donghua University, Shanghai, China, supported by a Chinese government scholarship. He holds an MSc in Textile Manufacturing and a BSc in Textile Engineering from Bahir Dar University, Ethiopia, along with a higher diploma in teaching.

His professional experience includes roles as production supervisor and shift leader at ALMEDA Textile PLC, and textile plant erection coordinator at SYGIN DIMA Textile SC, Ethiopia. At Bahir Dar University EiTEX, he served as tutor, lecturer, education quality officer, and director of the Textile Production Research and Innovation Center.

Degu Melaku Kumelachew over 10 peer-reviewed publications on topics like electrospun nanofibers for wound dressings, digital textile printing, and drug delivery systems. Proficient in English and Chinese (HSK3), he excels in SolidWorks, Abaqus, and research tools.



Sergio Moreno Martínez
University of Extremadura, Spain

Fabrication of Enamel-Inspired Composites by Polymer infiltration of SiOC Columnar Ceramic Structures Produced by DLP

Abstract

Natural materials provide paradigmatic examples of how complex microarchitectures can lead to outstanding mechanical performance. Human dental enamel is a prime example, exhibiting high strength, fracture toughness, and wear resistance as a result of its hierarchical organization. Enamel consists of densely packed, highly mineralised columnar units extending from the dentine–enamel junction to the occlusal surface, separated by a compliant intercolumnar phase. This arrangement enables effective crack deflection, load redistribution, and damage tolerance.

In this work, the feasibility of using direct digital light processing (DLP) as an additive manufacturing route for producing biomimetic columnar ceramic structures based on silicon oxycarbide (SiOC) is investigated. The objective is to reproduce key architectural features of dental enamel using discrete ceramic columns with controlled geometry and spacing. Straight and spiral columnar architectures are designed and fabricated using a photocurable resin loaded with SiOC precursor powders. Following printing, the green bodies are subjected to a debinding and pyrolysis–sintering process under a controlled nitrogen atmosphere to obtain ceramic structures composed of columns with a diameter of approximately 250 μm and an intercolumnar spacing of 250 μm.

To emulate the compliant phase present in natural enamel, the porous SiOC columnar frameworks are subsequently infiltrated with Recapoli 2196 polymer, resulting in

ceramic–polymer composite structures. The mechanical response of the fabricated architectures is evaluated through biaxial flexural testing, allowing comparison between straight and spiral column configurations. The results provide insight into the influence of column geometry on mechanical performance and evaluate the potential of direct DLP for manufacturing bioinspired SiOC-based composite architectures with enhanced damage tolerance.

Biography

My name is Sergio Moreno Martinez. I am 30 years old and I am an industrial chemical engineer. I am currently working on my doctoral thesis in materials engineering at the University of Extremadura, Spain.

Tatyana Kuperman
Tel Aviv University and Sheba Medical Center, Israel

Developing an autologous human nasal tissue-engineered cartilage implant for facial reconstruction surgeries

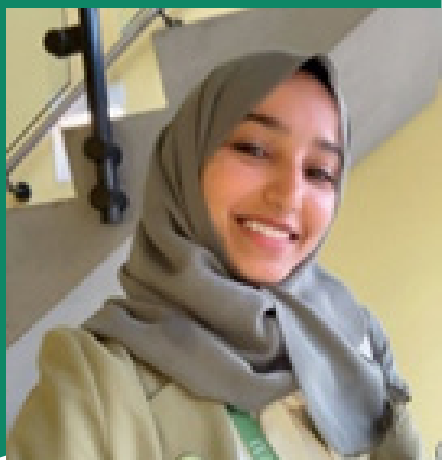
Abstract

Cartilage grafts are critical for reconstructing facial deformities, yet current options have major limitations. Autologous rib cartilage harvesting, while widely used, is invasive and poses risks such as warping and donor site morbidity. Synthetic implants and allografts often suffer from poor integration and high complication rates, reducing effectiveness. This project aims to develop engineered autologous cartilage strips, providing a mature, structurally stable graft that eliminates the need for invasive harvesting. Our approach utilizes chondro-spheroids instead of single cells, enhancing chondrogenic potential and extracellular matrix (ECM) deposition. We will optimize the identification, characterization, and in vitro growth of human nasal chondrocyte-derived spheroids as functional building blocks for cartilage tissue engineering. Then, we will apply these spheroids in scaffold-based systems to generate mature, implantable cartilage constructs. Three technologies will be used: (1) using biodegradable meshes and 3D-printed support devices and 3D bioprinting techniques: (2) Digital Light Processing (DLP) bioprinting and (3) Extrusion bioprinting. The biodegradable scaffold which fully degrades during ex vivo maturation, produces a scaffold-free, xeno-free cartilage graft.

Biography

Tatyana Kuperman, 32, is a doctoral student in the field of cartilage tissue engineering at the Tissue Engineering Laboratory of Sheba Medical Center, Israel's largest hospital. Her Ph.D. studies are conducted under the auspices of Tel Aviv University. Under supervision of Dr. Shay Izhak Duvdevani and Dr. Tomer Itkin.

Tatyana holds a Master's degree in Medical Sciences with a specialization in Tissue Engineering and a Bachelor's degree in Biology and Management, both from Tel Aviv University. Her current research focuses on the development and characterization of engineered cartilage constructs for regenerative medicine.



Ayat J Alansari
University of East Anglia

Altering Smooth Muscle Cell (SMC) Identification and Differentiation States to Understand the Role of SMC in Normal and Pulmonary Arterial Hypertension Phases

Abstract

Pulmonary arterial hypertension (PAH) is a debilitating and often fatal disease associated with reduced BMPR2signalling. Limited human tissue is available for study and usually only from patients with end-stage disease, making it difficult to understand how PAH is established and progresses. Furthermore, BMPR2 knockout mouse models are unable to recapitulate the full repertoire of phenotypes observed in humans. We therefore require alternative human models of PAH. We derived iPSCs from patients with BMPR2 mutations and used CRISPR-Cas9 gene editing to introduce two specific BMPR2 mutations into control iPSCs with no history of PAH. Using these cells, we generated the first human iPSC model of PAH involving the analysis of lineage-specific iPSC-derived pulmonary artery smooth muscle which recapitulate several PAH-associated phenotypes. These unique models with isogenic backgrounds revealed that a single BMPR2 mutation is sufficient to cause some PAH-associated phenotypes, but that other factors are necessary to enhance BMPR2-associated phenotypes in vivo. We next defined ways to control the transition between normal and diseased states in the model. For example, we showed that acquisition of the mitochondrial hyperpolarisation phenotype is enhanced by inflammatory signalling and requires an interaction between BMPR2 mutations and environmental stimuli provided by exposure to serum factors over time. We are now using the iPSC model to elucidate and track the mechanisms regulating disease initiation and progression in a way not possible before, and for validating therapeutic approaches to treat PAH.

Biography

I earned my Master's degree at the age of 25 from Thomas Jefferson University in the U.S.A. Currently, I am a senior laboratory specialist at Alnoor Specialist Hospital in Saudi Arabia. I am a Ph.D. candidate studying cardiovascular regenerative medicine and stem cell biology at the University of East Anglia, UK.

Dr. Didem Demir
Tarsus University, Turkiye

Scaffolds Decorated with Bioactive Graphene Quantum Dots for Diabetic Wound Healing

Abstract

Diabetic wounds are one of the most significant complications faced by diabetic patients, and despite clinical treatments, they have limited therapeutic efficacy in wound healing. In diabetic wounds, inflammatory macrophages persist in the wound area for extended periods compared to normal wound healing, prolonging healing time. Additionally, microbial contamination increases the risk of serious complications such as gangrene and sepsis. This increases healthcare costs and makes chronic wounds a significant social and economic problem.

Cryogel scaffolds, among the biomaterials used in wound healing, are emerging as noteworthy materials in this field. Cryogel matrices have large, interconnected pores that facilitate cell infiltration, promote homogeneous cell distribution, and support tissue formation. This structure facilitates the diffusion of drugs or bioactive agents applied to the wound. Their high fluid absorption capacity absorbs wound exudate and prevents fluid accumulation. In deep and chronic diabetic wounds with extensive tissue loss, cryogels serve as a temporary extracellular matrix, that facilitates cellular infiltration and new tissue regeneration.

In this study, bioactive graphene quantum dots (GQD@CURNPs) were obtained by combining naturally synthesized curcumin nanoparticles with graphene quantum, and their characteristics were analyzed. Cryogel scaffolds were obtained by adding GQD@CURNPs to an optimized polymer formulation based on chitosan and gelatin. The produced scaffolds were characterized by a series of physicochemical and biological

analyses to assess their potential use in diabetic wounds. This study aimed to increase the bioavailability and controlled release of curcumin encapsulated in quantum dots into cryogel scaffolds. The potential of the bioactive composite scaffolds produced with this approach will be evaluated for the treatment of deep, slow-healing chronic wounds characterized by extensive tissue loss in diabetic patients.

Biography

Didem Demir, Ph.D., received her doctoral degree in Chemical Engineering from Mersin University in 2021. She is currently an Associate Professor at Tarsus University in Mersin, Türkiye. Her expertise centers on the development and characterization of biomaterials—including gels, nanofibers, and micro- and nanoparticles—for tissue engineering applications such as tissue regeneration, wound healing, controlled drug delivery, and in vitro cancer modeling. Her research interests also encompass the extraction and utilization of natural polymers and bioactive compounds. To date, Dr. Demir has authored more than 50 scientific articles, 10 book chapters, and more than 60 conference proceedings.

Dr. Dongxu Ke
Nanjing University Suzhou Campus, China

3D printed bioactive coated scaffolds boost osteogenesis and angiogenesis via the regulation of scaffold microstructure

Abstract

Microstructure plays a crucial role in bone regeneration, conventional bone tissue engineering scaffold fabrication techniques often lack the precision required to control microstructural features that can optimize bone healing. 3D printing, as a powerful tool for biofabrication, allows for the design and optimization of scaffold microstructures to enhance bone healing. In this study, bioactive coated scaffolds composed of polycaprolactone and tricalcium phosphate were fabricated using a micro-extrusion 3D printer with varying compositions and microstructures, resulting in different physical and mechanical properties. Among these properties, porosity and permeability played a vital role in osteogenic and angiogenic differentiation. In vitro studies revealed that the permeability effect was dominant in osteogenic differentiation, while the porosity effect mainly induced the angiogenic differentiation, with potential mechanisms involving crosstalk between Wnt and PI3K signaling pathways. Moreover, significantly improved osteogenesis and angiogenesiswere observed in U600 scaffolds compared to sham and U300 scaffolds, supporting the in vitro findings. This study provides valuable insights for the microstructure optimization of 3D printed tissue engineering scaffolds, which could facilitate the translation of 3D printing technology from the benchside to clinical applications.

Biography

Prof. Dongxu Ke finished his PhD from Washingtong State University and postdoctoral investigations from Wake Forest Institute for Regenerative Medicine. He was previously an entrepreneur as the chief technology officer of Novaprint Therapeutics. He is now the associate proferssor in Nanjing University. He has published in excess of 25 scientific papers and book chapters in high-impacted journals in the field of tissue engineering and regenerative medicine.

Ms. ZHANG Kejia
University of Hong Kong, Hong Kong

Multiresponsive Nanorobots: Manipulation Strategies and Biomedical Applications

Abstract

The rapid advancement of nanotechnology has enabled the creation of functional micro- and nanoscale structures with transformative potential in biomedicine. Among these innovations, multiresponsive micro/nanorobots represent versatile platforms capable of performing targeted tasks in an on-demand manner. In this work, I present a novel nanorobot engineered to integrate responsiveness to chemical stimuli, light, and magnetic fields, thereby achieving adaptive locomotion, multifunctionality, and programmable energy input. Through biomedical applications in biofilm elimination and modulation of cellular behavior, the nanorobot demonstrates potent antibacterial properties, alleviates hypoxia, mitigates oxidative stress, and constructs a normoxic microenvironment conducive to tissue regeneration. These findings highlight the promise of multiresponsive nanorobots in overcoming the limitations of conventional medical tools and pave the way for next-generation strategies in infection control and regenerative medicine.

Biography

She is a PhD student at HKU. She has dedicated several years to nanotechnology and biomedical research, gaining extensive experience in the design and development of nanomaterials for therapeutic applications. Her current research focuses on the development of multifunctional nanorobots for biomedical applications.

Dr. Jiaxin Guo
The University of Hong Kong, Hong Kong SAR

Spatially Programmed Delivery of Therapeutic Exosomes via Microneedle Patches for Alveolar Bone Regeneration

Abstract

Periodontitis, osteosarcoma, and osteonecrosis can lead to the destruction of the periodontal complex, including the alveolar bone and surrounding soft tissue. Achieving alveolar bone regeneration in the challenging microenvironment with impaired angiogenesis, immune dysregulation, and potential infection—remains a significant hurdle. Our previous work introduced an injectable hydrogel substitute to promote mandible healing, offer the new clinical therapies of minimally invasive therapies.

While cell-derived biomolecules hold great therapeutic promise, their clinical application depends on delivery systems that provide sustained, spatially controlled release. Bone marrow-derived mesenchymal stem cell exosomes (BMSC-Exos) represent a promising cell-free therapeutic, as they carry osteogenic cues such as bone morphogenetic proteins, growth factors, and immunomodulatory microRNAs to initiate vascularization and bone formation. In this study, we engineered a bilayer microneedle (MN) patch for the compartmentalized and sustained delivery of BMSC-Exos and anti-inflammatory drug. We first successfully isolated BMSC-Exo and verified its pro-osteogenic properties, cellular uptake efficiency, and therapeutic cargo. Then, the MN patch was fabricated from a biodegradable polyvinyl alcohol-based material, with a bilayer design providing the different cargoes releasing and mechanical strength suitable for integration with both hard and soft tissues. After characterizing the patch's mechanical properties and release kinetics, we evaluated its therapeutic efficacy in a rat alveolar bone defect model. Micro-CT and histological analyses revealed that the exosome-loaded microneedle patch effectively guided the bone regeneration by activating Osx+ osteoprogenitor cells and reducing local inflammation.

In summary, this study developed a spatially programmed exosome-delivery platform that enabled the sustained release of therapeutics to drive alveolar bone regeneration. As a potent and scalable technology, this microneedle patch offers a new paradigm for achieving holistic periodontal tissue repair and treating complex bone defects.

Biography

Dr. Jiaxin Guo earned her PhD in 2024 from the Department of Orthopaedics and Traumatology at The Chinese University of Hong Kong under the supervision of Prof. Ling Qin. She is currently a Postdoctoral Researcher at the Advanced Biomedical Instrumentation Centre (ABIC), a University of Hong Kong initiative at the Hong Kong Science Park. With nearly 20 publications in top-tier journals, Dr. Guo's research focuses on biomimetic materials for musculoskeletal repair, advanced drug delivery systems and clinical translation of new implants. She has first-authored papers in prestigious journals including Advanced Materials, Materials Today, and ACS Nano. Her work has been recognized with awards such as the Gold Award in the TERMIS-AP student contest (2023) and a Gold Medal at the International Exhibition of Inventions of Geneva (2024). At ABIC, she also contributes to commercializing tumor organoid platforms for personalized drug screening.

Ms. Tsui Sharmane Fion
Hong Kong

Enhancing mRNA Therapeutics for Laminopathy: Investigating Diverse Delivery Systems

Abstract

Background: Genetic mutations that affect cardiac function, such as those associated with laminopathy and other cardiomyopathies, can lead to severe complications, like heart failure and arrhythmias. To address these issues, effective mRNA therapeutics must successfully deliver payload to the heart. In this context, much research has focused on exploring strategies to enhance the delivery of mRNA therapies to cardiac tissues. Alogna and colleagues reported that inhaling dry powder drugs targeting L-type calcium channels (LTCC), which regulate cardiomyocyte contractility significantly improved the outcomes of tachycardia-induced cardiomyopathy. Building on these findings, we aim to determine whether a similar approach can be applied to mRNA therapy, based on the premise that mRNA can enter the cardiopulmonary circulation.

Methods: To evaluate the delivery of mRNA, ICR (CD-1) mice were intubated for intratracheal administration of Firefly-luciferase-mRNA-lipid nanoparticles (FLuc-mRNA-LNP) via a microsprayer. After administration, the mice were dissected to analyze the distribution of mRNA through an in vivo imaging system (IVIS) at various timepoints: 5hrs, 24hrs and 48hrs post administration.

Results: IVIS imaging demonstrated that luciferase mRNA predominantly localized within the pulmonary tissues at all timepoints. Notably, detectable bioluminescence from the heart in the treated mice did not significantly differ from baseline untreated controls, indicating inadequate delivery to cardiac tissues. At 5 hrs, most LNPs were retained in the lungs. By 24hrs, some LNPs were observed in the liver, and at 48

hrs, there was a marked decrease in the lung signal, accompanied by increased accumulation within the liver and spleen. The appearance of signal in the liver and spleen indicate that the mRNA entered systemic circulation after being introduced into the pulmonary circulation, but its retention in the heart remains short and requires optimization.

Conclusion: While intratracheal administration of luciferase-mRNA localised in the lungs, delivery to the heart remained insufficient. Future investigations will prioritize the optimization of LNP formulations or the in cooperation of aptamers to enhance mRNA distribution to cardiac tissues.

Biography

Sharmane is in her second year of her PhD Studies at the University of Hong Kong, where her main research focus is gene therapy for the treatment of cardiovascular diseases. Specifc interests include optimising potential biomaterials as novel carriers and localised delivery to specific organs. In addition to academic work, she is also involved with the Advanced Biomedical Instrumentation Centre (InnoHK), enabling collaboration with biomaterial experts. This role provides access to advance equipment and resources, facillitating the translation of academic studies with practical industry applications.

Ms. Elles Catharina Boonstra
University Medical Center Groningen, Netherlands

Real-time insights into biomaterial-host interactions: intravital imaging of the cellular and infectious response to wettability-tuned PDMS coatings

Abstract

The success of implanted biomaterials is influenced by the foreign body response (FBR), a complex multifaced immune response that governs fibrotic encapsulation. Moreover, implant success is also hindered by difficult-to-eradicate biomaterial-associated infections (BAI). To optimize implant design and increase their success, a deeper understanding of the interactions between biomaterial surfaces and host cells is crucial.

This study investigated the impact of surface wettability on the biocompatibility og polydimethylsiloxane (PDMS) coatings, modified via plasma treatment to yield 3 distinct wettability profiles. Both antimicrobial properties and cellular responses of fibroblasts and macrophages were evaluated in vitro. The coatings significantly modulated myofibroblast differentiation and bacterial cell adhesion, whereas macrophage polarization exhibited less variation across the different coatings.

To translate these findings to in vivo, a novel “FBR-through-a-window” model was applied, enabling longitudinal two-photon imaging of immune cell dynamics and fibrotic encapsulation using an imaging window as the foreign body itself. This approach revealed distinct temporal and spatial patterns of neutrophils, macrophages, fibroblasts and collagen for the different coatings. The induction of a biomaterial-associated infection influenced the spatiotemporal response, but differences in biofilm formation were less pronounced.

These findings of this study underscore the pivotal role of material design in

modulating the FBR and infection outcomes. Moreover, they highlight the value of intravital imaging for elucidating dynamic cell-material interactions, offering a powerful platform to inform the rational design of next-generation biomaterials with enhanced biocompatibility and infection resistance.

Biography

Elles finished her masters in Infection and Immunology in 2020 from Utrecht University in the Netherlands in 2020. After working as a specialist in a high volume COVID19 diagnostics lab for 1,5 years, she started her PhD at the University of Groningen in the Netherlands in 2022. Here, she focuses on the cellular foreign body response and antimicrobial capacity of implant coatings in in vivo imaging models.

Justin Ching Yin Lau
Cornell University, USA

Modeling Breast Cancer Extracellular Vesicle–Mediated Degradation of the Lymphatic Glycocalyx using a 3D Organ-on-Chip Platform

Abstract

Lymphatic vessels are the primary route of early metastatic dissemination in breast cancer, yet how tumor-secreted factors condition the lymphatic endothelium remains unclear. The endothelial glycocalyx (GCX), a carbohydrate-rich barrier on lymphatic endothelial cells (LECs), plays a vital role in maintaining vessel integrity, mechanotransduction, cell-cell signaling, and regulating immune cell trafficking. Here, a 3D lymphatic vessel-on-chip model was developed to investigate how triple-negative breast cancer (TNBC)–derived extracellular vesicles (EVs) mediate GCX degradation. The microfluidic platform mimics native lymphatic architecture and applies physiological shear and hydrodynamic forces that are essential for robust GCX expression, yielding a 2.9-fold increase in heparan sulfate signal and greater VE-cadherin organization compared to 2D cultures. Co-culture of LECs with MDA-MB-231 cells led to near-complete GCX loss, mirroring heparinase-induced degradation. Proteomic profiling revealed that TNBC EVs are enriched with unique proteases—including ADAM9, MMP-8, and Cathepsin X/Z/P—capable of cleaving GCX components. These findings establish a mechanistic link between cancer EV cargo and lymphatic GCX degradation, suggesting that protease-mediated remodeling reduces endothelial barrier resistance and facilitates metastatic entry. Current and ongoing work continues to leverage this 3D lymphatic vessel-on-chip system to explore inhibition of EV secretion and protease activity, aiming to preserve GCX integrity and prevent lymphatic metastasis.

Biography

Justin Lau is a Biomedical Engineering student at Cornell University conducting research in the Esak Lee Lab at Cornell University. His work focuses on organ-on-chip systems to model vascular biology and metastasis, emphasizing how tumor-derived extracellular vesicles influence the lymphatic endothelial glycocalyx. He has over seven years of experience across academia and industry, including research internships at SonoThera and Merck. His broader interests lie in integrating biomaterials and microphysiological systems to uncover mechanisms of disease and identify therapeutic strategies for cancer progression.

Seth Kinoshita
Georgia Institute of Technology, USA

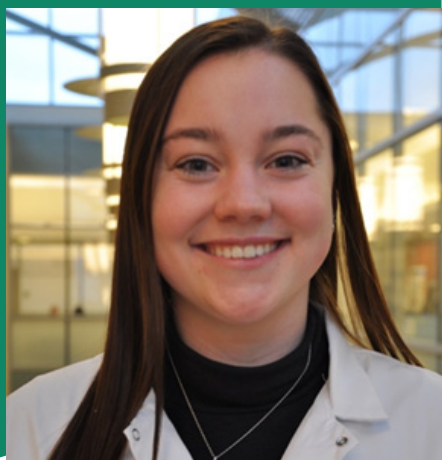
A novel bi-directional and bi-temporal delivery system for enhancing intrasynovial tendon repair

Abstract

Flexor tendon injuries are common and often require surgical repair and prolonged rehabilitation. Successful clinical outcomes depend on the concurrent suppression of adhesions (caused by inflammation) at the tendon surface and promotion of matrix synthesis inside the tendon. Herein, we report a bi-directional and bi-temporal drug delivery system designed to target both the initial inflammatory phase and the subsequent proliferative and remodeling phases of healing to improve outcomes after flexor tendon repair. The system features a multi-layered design with anti-adhesion and pro-matrix factors encapsulated in separate layers of hyaluronate films crosslinked to different degrees to control their direction and rate of release. After validating drug delivery under controlled release, cell culture experiments involving tendon fibroblasts and a Transwell system are conducted to demonstrate the system's efficacy in modulating local cellular responses. The promising results from this study lay the groundwork for moving this system toward in vivo testing and clinical translation.

Biography

Seth Kinoshita is an undergraduate student who is about to graduate from Georgia Tech with his Bachelor's in Biochemistry. He plans on pursuing an MD/PhD with a focus in biomaterials for regenerative engineering for translational purposes. He has published three papers within the lab of Dr. Younan Xia and has three more in development that are slated for publication in Summer 2026.



Madison O'Brien
Purdue University, USA

Spatiotemporal Mapping of Lung Tissue Mechanics During Breast Cancer Metastasis Using a Novel In-Plane Actuation Platform

Abstract

Metastasis is the single greatest driver of breast cancer (BC) related mortalities, where BC cells commonly metastasize to regions of high mechanical stress, including the lungs. Previous studies have found BC cells detect mechanical changes in their microenvironment and consequently alter their function or behavior. During disease progression, changes in the extracellular matrix (ECM) architecture and composition occur at distant sites, leading to altered tissue mechanical properties. Despite the recognized importance of tissue mechanics, the temporal evolution of ECM material properties during metastasis remains poorly understood largely due to the lack of accessible, high-sensitivity tools for ex vivo mechanical characterization. Here, we present an in-plane actuation platform that enables high-resolution tensile testing and live imaging of small, heterogeneous tissue samples. This simple, low-cost, and modular system quantifies tissue mechanics with precision comparable to commercial instruments, while remaining compatible with downstream biochemical and histological assays. We demonstrate the device utility for ex vivo tissue characterization by analyzing transient mechanical changes in murine metastatic lung tissue. Following orthotopic implantation of 4T1 BC cells, we performed tensile testing of healthy, early metastatic, and late metastatic lung tissues to capture dynamic changes in tissue mechanics over time. Our platform revealed distinct heterogenous strain distributions across lung samples, highlighting spatial variations in ECM biomechanics during disease progression. Given that the ECM is a main driver of tissue stiffness, this study

was paired with a proteomic analysis to identify transient changes in ECM composition throughout disease progression. Together, these data provide a comprehensive analysis of the evolving metastatic microenvironment and demonstrates the device potential for dynamic tissue analysis and translational applications in biomaterial development.

Biography

Madison O'Brien is a PhD candidate in Dr. Luis Solorio's Tissue Microenvironment and Therapuetics lab at Purdue University. Her research integrates biomaterials into engineered biomimetic platforms to investigate how mechanical cues regulate metastatic breast cancer progression. Madison also brings industry experience in early-feasibility R&D, where she contributed to the development of biomaterial-based and tissue-engineered medical devices. She earned both her MBA and B.S. in Biomedical Engineering from Trine University and is an inventor on a patent and author on multiple peer-reviewed publications.

Mrs. Ganga Neeharika Addula
Queen's University Belfast, UK

Development of Antimicrobial Biodegradable Sutures Using Polymeric and Deep Eutectic Reactive Systems via Hot-Melt Extrusion

Abstract

The growing global threat of antimicrobial resistance (AMR) and the persistent incidence of surgical site infections demand next-generation medical sutures capable of both tissue repair and localized infection control. Conventional antimicrobial sutures often rely on surface coatings that deliver a rapid, short-term drug burst with limited control over release kinetics and poor long-term efficacy. The present study proposes an innovative approach that integrates Deep Eutectic Systems (DES) into biodegradable polymer matrices using hot-melt extrusion (HME) to develop reactive, multifunctional antimicrobial sutures. The eutectic components, selected from pharmaceutically acceptable hydrogen bond donors and acceptors, are engineered to enhance drug solubility, stability, and uniform molecular dispersion within the polymeric phase.

The conceptual design involves a dual-function platform combining mechanical strength and tuneable drug release with a sustainable, solvent-free fabrication process. Analytical characterization using DSC, FTIR, PXRD, and TGA will elucidate molecular interactions and thermal behaviour, while HPLC/UV–Vis will quantify controlled release kinetics. Mechanical integrity and antimicrobial efficacy will be validated through tensile testing and zone of inhibition (ZOI) assays.

This project pioneers a new paradigm in biomaterial-based infection control, shifting from passive coatings to intrinsic antimicrobial architectures. The proposed DES-polymer hybrid system aims to minimize drug loss, extend antimicrobial lifetime, and reduce cytotoxicity, ultimately contributing to the development of sustainable,

patient-safe medical sutures. This research not only addresses the critical challenge of AMR but also aligns with the global movement toward greener pharmaceutical manufacturing and regenerative healthcare innovation.

Keywords:
Antimicrobial sutures; Deep eutectic systems; Hot-melt extrusion; Biomaterials; Drug delivery; Sustainable medical devices.

Biography

Ganga Addula is a PhD researcher at the School of Pharmacy, Queen's University Belfast. Her current work focuses on the development of multifunctional antimicrobial sutures using deep eutectic reactive systems and hot-melt extrusion. She previously gained industry experience in pharmacovigilance and quality control, with expertise in analytical techniques including HPLC, FTIR, DSC, and UV-Vis. She is a student member of the Royal Society of Chemistry and is passionate about advancing sustainable biomedical materials that combat antimicrobial resistance.

Yousra Mohamed
Newcastle University, United Kingdom

A Promising Injectable Chitosan/Pectin Methacrylate Hydrogel Infused with Cnicin for Peripheral Nerve Repair

Abstract

Peripheral nerve injuries (PNIs) represent a major clinical and socioeconomic concern due to their complexity and the profound impact they have on patient outcomes, including disabilities, pain and psychological challenges. These injuries often lead to significant sensory and motor deficits, with recovery times ranging from several months to years. While the peripheral nervous system (PNS) has a unique ability to regenerate, several factors influence the success of this process, including the severity of the injury, the size of the nerve gap, and the timing of intervention. In cases of minor injuries with small gaps, natural regeneration can often proceed smoothly. However, severe PNIs with larger gaps usually require surgical interventions. Furthermore, several biological factors can hinder nerve regeneration, such as a complex immune response, scar tissue formation, excessive debris, and oxidative stress. These complications underscore the critical need for improved treatment strategies and innovations in nerve repair to enhance outcomes and reduce both direct and indirect costs associated with these injuries.

This study presents the development of a dual biomaterial platform intended for future application in peripheral nerve repair. It consists of a temperature-sensitive injectable hydrogel and an electrospun nerve conduit. The injectable hydrogel was synthesized using chitosan (CH) and cocoa husk-derived pectin methacrylate (PECMA). This CH/PECMA hydrogel demonstrated favorable biocompatibility, suitable mechanical properties, and a porous, three-dimensional morphology that facilitates nutrient diffusion, waste removal, and cellular proliferation.

As part of its design, the hydrogel incorporated with Cnicin, a naturally occurring

phytochemical recently identified by researchers at the University of Cologne for its potential to stimulate axonal growth. The hydrogel exhibited a concentration-dependent, sustained drug release profile. At 0.05% (w/v) Cnicin loading, ~80% was released over 72 hours, while a 0.025% formulation released ~61% in the same period. In vitro biocompatibility was evaluated using L929 mouse fibroblast cells. The 0.025% Cnicin-loaded hydrogels maintained high cell viability, whereas the higher concentration resulted in decreased viability, likely due to a combination of Cnicin's known cytotoxicity at elevated doses and its rapid release profile.

Simultaneously, electrospinning was used to fabricate a polycaprolactone (PCL) conduit that encapsulated the bioactive hydrogel core and provided structural guidance. Processing parameters such as voltage, flow rate, and needle-collector distance were optimized to produce bead-free, uniform nanofibers with an average diameter of 282.8 ± 121 nm, mimicking the extracellular matrix and providing essential cues that encourages nerve regeneration.

Although biological testing in this study was limited to fibroblast cell lines, the materials showed promising characteristics for future use in peripheral nerve repair. The CH/PECMA hydrogel provides a controlled delivery platform for regenerative agents like Cnicin, while the PCL conduit is evidenced to offer physical guidance to support axonal growth. Future studies will focus on in vitro experiments with neural cells to further evaluate the therapeutic potential of this system.

Biography

Yousra Mohammed earned her B.Sc. and M.Sc. in Biomedical Engineering from the University of Medical Sciences and Technology (UMST), Sudan in 2015 and 2017, respectively. She began her academic career at UMST, where her early research focused on MATLAB-based disease classification. In 2018, she began her Ph.D. in Bioengineering at Cyprus International University (ABD), exploring green-synthesized nanoparticles and bioinspired natural biomaterials.

In 2023, she was awarded the prestigious UK Chevening Scholarship to pursue an M.Sc. in Biomechanics at Newcastle University, graduating with distinction and receiving the Best Biomedical Engineering Project Award. She is currently working on bio-inspired hydrogels for tissue engineering applications, with research interests in biopolymers, regenerative medicine, and sustainable healthcare solutions.

Sara Ali Hosseinzadeh
The University of Manchester, UK

Development of Peptide–Chitosan Hydrogel Composites for Wound Healing Applications

Abstract

Chronic and infected wounds continue to present a significant healthcare burden, driving the need for advanced wound dressings that combine antibacterial efficacy with regenerative potential. Peptide-based hydrogels offer attractive properties—including biodegradability, biocompatibility, and extracellular matrix mimicry—but their clinical utility is limited by weak mechanical performance and insufficient antimicrobial activity. In this work, we engineered composite hydrogels by integrating a self-assembling peptide with chitosan, a natural polysaccharide with intrinsic antimicrobial properties. FTIR analysis confirmed the preservation of peptide β-sheet structures and revealed additional interaction peaks, supporting peptide–chitosan integration. Rheological studies demonstrated a marked enhancement in storage modulus upon chitosan incorporation, indicating improved mechanical stability. Antibacterial testing against both Gram-positive bacteria and Gram-negative bacteria, combined with TEM and SEM imaging, showed that the composite hydrogel caused pronounced membrane collapse in bacteria, compared with the more modest effects of peptide or chitosan alone.

Collectively, these findings demonstrate the synergistic reinforcement and broad-spectrum antimicrobial activity of peptide–chitosan hydrogels, underscoring their potential as next-generation wound healing materials. Current work is focused on further optimizing antibacterial efficacy and advancing these composites toward clinically translatable dressing formats.

Biography

Sara Ali Hosseinzadeh, MRSC, is a PhD researcher at the University of Manchester, developing peptide–chitosan hydrogel composites for wound healing under the supervision of Prof. Alberto Saiani and Prof. Aline Miller. She holds a Master's degree from Tarbiat Modares University and previously worked as a laboratory expert at the Pasteur Institute of Iran in the Nano-biotechnology Department. She has published 9 research papers in international peer-reviewed journals. She was awarded a fully funded PhD studentship at Manchester. Alongside her research, she contributes to undergraduate education as a Teaching Assistant (TA) in the Faculty of Science and Engineering.

Dr. Julia Bellvik
University of Borås, Sweden

Valorization of Eggshell Waste into Bioceramic-Coated Textile Scaffolds for Bone Tissue Engineering

Abstract

Growing health demands and sustainability goals are driving efforts to integrate bioeconomic principles into medical innovation, especially for treating critical-size bone injuries that require alternatives to traditional implants and grafts. This study developed biodegradable textile scaffolds for bone tissue engineering by braiding melt-spun poly(3-hydroxybutyrate)/poly(3-hydroxybutyrate-co-4-hydroxybutyrate) monofilaments and coating them with bioceramics. Hydroxyapatite (HA) and carbonated hydroxyapatite (CHA) were synthesised from waste eggshells, providing a low-cost, sustainable calcium source. Scaffolds were coated with HA, CHA, or a 50/50 mix. Human mesenchymal stem cells were used to evaluate cellular response. Early cell attachment (3 hours, 4 days) and osteogenic differentiation (2-3 weeks) were assessed using cell staining, viability assays, and alkaline phosphatase activity. Coated scaffolds improved early cell attachment and spreading compared to uncoated controls. Cells remained viable at all time points, confirming a positive cellular response. HA-coated scaffolds showed the highest osteogenic activity and osteoblast-like morphology. These findings support the use of eggshell-derived ceramic coatings on biodegradable textile scaffolds as a sustainable strategy for bone regeneration, offering a pathway to integrate bioeconomy principles into biomedical material development.

Biography

Julia Bellvik recently graduated from the World Textile Engineering Advanced Master (WE-TEAM) program, an international joint master's framework focused on advanced textile materials, processes, and innovation. During the program, she gained interdisciplinary experience across leading global institutions in textile engineering. Her master's thesis was completed as part of the WE-TEAM initiative, focusing on textile scaffolds for bone tissue engineering

Dr. Kemache Bilel

Medical Biology Department - Beni Messous University Hospital – Algiers

The role of molecular biology in the management of colorectal cancers

Abstract

Molecular biology is playing an increasingly important role in the management of cancers in general, and colorectal cancers in particular.

For a long time, colorectal cancers were treated as a single entity, but thanks to the contribution of molecular biology, many therapeutic advances have been made, enabling personalized treatment based on specific molecular guidance for each patient.

Indeed, molecular biology has made it possible to identify predictive factors of efficacy or inefficacy (RAS gene mutations for anti-EGFR therapies and MSI status for the indication of adjuvant chemotherapy in stage II and immunotherapy in stage IV). It also makes it possible to identify prognostic factors (BRAF gene mutations) that justify intensifying treatment. The involvement of these various factors in therapeutic choice has made it possible to avoid administering toxic treatments with no chance of efficacy, but above all, to significantly improve patient survival.

In our presentation, we will discuss the various biological factors or markers that are currently involved, as well as the prospects of molecular biology in the management of colorectal cancers.

Dr. Natalia Lemos Chaves

Victor Hugo Braga da Silva; Suelia de Siqueira Rodrigues Fleury Rosa; Marcella Lemos Brettas Carneiro, Brazil

Innovative Protein-Based Formulations from Hevea brasiliensis Latex for Advanced Tissue Regeneration

Abstract

Hevea brasiliensis (Brazilian rubber tree) is a tropical latex-producing plant belonging to the Euphorbiaceae family, native to the rainforests of the Amazon basin. Latex serum proteins, particularly the FrHB1 (F1) fraction, have been shown to induce tissue repair and enhance vasculogenesis. Research advancement and the prospects for its large-scale use are limited by the inherent challenges of the natural extraction method, which is difficult in terms of access to the raw plant and the lack of standardization required for industrial scale. Recently, collaborators in our group developed a method to extract and purify the F1 protein fraction from industrialized natural latex (F1FINL), further increasing the therapeutic potential of this fraction and enabling the incorporation of robust innovative approaches for pharmacological delivery of F1, such as nanotechnology. In this context, this study aimed to validate the maintenance of F1FINL biological properties in vitro through cell viability and cell migration assays. The results showed that F1FINL maintained similar cell proliferation-inducing characteristics (fundamental in the healing process) as those previously reported for F1 from natural extraction. These results support the potential for applying this extraction method's methodology for pharmacological application in a scaled-up translational perspective.

Biography

She completed her doctorate at the University of Brasília (UnB) and completed a sandwich doctoral project in Leipzig, Germany, developing a study related to the treatment of breast cancer with magnetic nanoparticles. She has experience in electron, confocal, and Raman confocal microscopy, flow cytometry, and cell culture. Since 2010, she has worked in a clinical analysis laboratory (SES-DF), where she gained experience in hematology, urinalysis, biochemistry, and hematology. She currently works as a postdoctoral researcher at the Laboratory of Bioactive Compounds and Nanobiotechnology (UnB).

Ms. Amrita Das
Presidency University, India

Eco-friendly Extraction of Bioactive Keratin Using Deep Eutectic Solvent and Its Application in Keratin–PCL Nanofiber Scaffolds for Wound Healing

Abstract

Keratin, a structural protein known for its biocompatibility and intrinsic bioactivity, is an attractive biomaterial for tissue engineering and wound healing. Human hair provides a sustainable keratin source; however, conventional extraction methods often employ harsh chemicals that compromise protein structure and diminish the mechanical integrity of resulting biomaterials. This study demonstrates a green, efficient deep eutectic solvent (DES)–based approach for keratin extraction and evaluates the suitability of DES-derived keratin for fabricating keratin–polycaprolactone (PCL) nanofibers for wound healing applications. Keratin was extracted using a choline chloride–urea DES and blended with PCL for electrospinning. FTIR spectra confirmed the preservation of characteristic keratin functional groups, while XRD analysis indicated retained β-sheet structures. SEM imaging revealed smooth, bead-free nanofibers with homogeneous keratin incorporation. Compared with reduction and ionic liquid methods, the DES route yielded higher extraction efficiency and superior structural integrity. Mechanical testing showed enhanced flexibility upon keratin addition, and in-vitro cytocompatibility assays using fibroblasts demonstrated improved cell adhesion, proliferation, and metabolic activity on keratin–PCL nanofibers relative to pure PCL. Hemocompatibility tests indicated negligible hemolysis, confirming scaffold safety. Overall, the DES-mediated extraction process offers a sustainable strategy to obtain structurally preserved keratin, and the resulting nanofiber scaffolds exhibit strong potential for advanced wound healing applications. Future studies will investigate optimized formulations and in-vivo wound repair efficacy.

Biography

Amrita Das is a PhD scholar in Biomaterials at Presidency University, Kolkata, working under the guidance of Dr. Paulomi Ghosh. Her research focuses on developing sustainable keratin-based biomaterials for wound healing and food packaging applications, with a special emphasis on green keratin extraction using deep eutectic solvents and the fabrication of keratin–PCL nanofiber scaffolds. She has successfully developed bioactive keratin with superior antioxidant properties and engineered cytocompatible nanofibers for biomedical use. Her doctoral work is supported by a SERB-SURE project, and her scientific contributions have been recognized through her abstract selection for ESB 2025 in Turin, Italy. She has also been awarded the prestigious DBT Travel Grant Award to support her international scientific presentation. Amrita is proficient in advanced biomaterials characterization techniques and cell-based assays and actively seeks interdisciplinary collaborations in translational tissue engineering and sustainable biomaterial development.

Dr. Mukul Machhindra Barwant
Commerce and Science College, India

Plant-Based Nutraceuticals and Their Biomedical Applications

Abstract

Plant-based nutraceuticals represent an important interface between nutrition and medicine, offering significant potential for health promotion and disease prevention. Derived from fruits, vegetables, cereals, legumes, medicinal plants, and herbs, these nutraceuticals are rich sources of bioactive phytochemicals such as polyphenols, flavonoids, alkaloids, terpenoids, carotenoids, and glycosides. Extensive biomedical studies have demonstrated that plant-derived nutraceuticals exhibit a wide spectrum of biological activities, including antioxidant, anti-inflammatory, antimicrobial, anticancer, antidiabetic, cardioprotective, neuroprotective, and immunomodulatory effects. Their therapeutic efficacy is primarily associated with their ability to modulate molecular signaling pathways, regulate oxidative stress, enhance immune function, and maintain metabolic homeostasis. Recent advancements in extraction technologies, formulation approaches, and nano-based delivery systems have further improved the bioavailability, stability, and clinical applicability of plant-based nutraceuticals. Due to their natural origin, safety profile, cost-effectiveness, and high consumer acceptance, these compounds are increasingly incorporated into functional foods, dietary supplements, and preventive healthcare strategies. This abstract highlights the classification, sources, mechanisms of action, and key biomedical applications of plant-based nutraceuticals, emphasizing their growing role in modern healthcare and sustainable biomedical innovation.

Biography

Dr. Mukul Machhindra Barwant is the Dean of Research and Innovation and Assistant Professor in the Department of Botany at Sanjivani Arts, Commerce and Science College, Kopargaon, Maharashtra, India. He has extensive expertise in phycology, nutraceuticals, herbal biotechnology, and environmental sciences. Dr. Barwant has edited more than 45 books, authored over 29 book chapters, and published 59+ research articles in reputed international journals. He serves on the editorial boards of over 25 international journals and holds more than 25 patents in the areas of seaweed-based nutraceuticals and pharmacology. He has received several prestigious awards, including the Young Scientist Award, Distinguished Researcher Award, and Outstanding Research Contribution Award.

Dr. Nida Nehal
School of Pharmaceutical Education and Research, India

Surface-Engineered Nanostructure Lipid Carrier for Targeted Delivery of a CDK Inhibitor for Breast cancer therapy

Abstract

Breast cancer remains a major global health challenge despite significant advances in early detection and treatment that have reduced mortality rates. It continues as the second leading cause of cancer-related deaths among women worldwide. To address this challenge, surface-modified nanostructured lipid carriers (NLCs) administered intravenously enhance targeted drug delivery to tumor sites, improving therapeutic efficacy while minimizing systemic toxicity. This study involved synthesis of distearoylp hosphatidylethanolamine-poly(ethylene glycol)2000-folic acid (DSPE-PEG2000-FA), NLC conjugation with DSPE-PEG2000-FA, characterization of conjugated NLCs, in vitro evaluation, and in vivo pharmacokinetic analysis. Synthesis of DSPE-PEG2000-FA conjugate comprised four major steps: (i) folic acid activation, (ii) coupling to DSPE-PEG2000-NH2, (iii) purification, and (iv) lyophilization. The conjugate was characterized using NMR. Surface-engineered NLCs developed with this conjugate exhibited an average particle size of 177.73 ± 7.5 nm, PDI of 0.2578 ± 0.009, and zeta potential of -18.40 ± 1.84 mV. Surface morphology using Transmission electron microscopy revealed nanoparticles are evenly distributed without any visible aggregation, and each particle exhibited a spherical shape. The conjugated NLC exhibited minimal hemolysis of 1.92% ± 0.020 as compared to 2.56% ± 0.025 observed with drug-suspension exhibiting compatibility with red blood cells (RBCs). In vitro cell viability assays on MDA-MB-231 cells revealed that folic acid-conjugated NLCs were 3.5-fold more cytotoxic than non-conjugated NLCs. Cellular uptake studies showed fluorescence intensity (measured via ImageJ software) approximately 7-fold higher for conjugated NLCs compared to non-conjugated NLCs. In vivo pharmacokinetic studies demonstrated a 5.06-fold increase in bioavailability compared to drug suspension.

Biography

Nida Nehal recently completed a Ph.D. in Pharmaceutics from Jamia Hamdard University, New Delhi, India, with thesis research focused on advanced nanostructured lipid carrier (NLC) systems for targeted breast cancer therapy. She has authored peer-reviewed research articles as first author and contributed as co-author to additional publications in journals of repute. Currently pursuing postdoctoral opportunities in nanomedicine and targeted drug delivery. She specializes in surface-engineered nanoparticles, in vivo study, and folate receptor-targeted therapeutics. She has presented at national conferences as well as international conferences.

Vaibhav Thirumalai
Case Western Reserve University, USA

Emerging Sensing Platforms for Epilepsy Care and Management

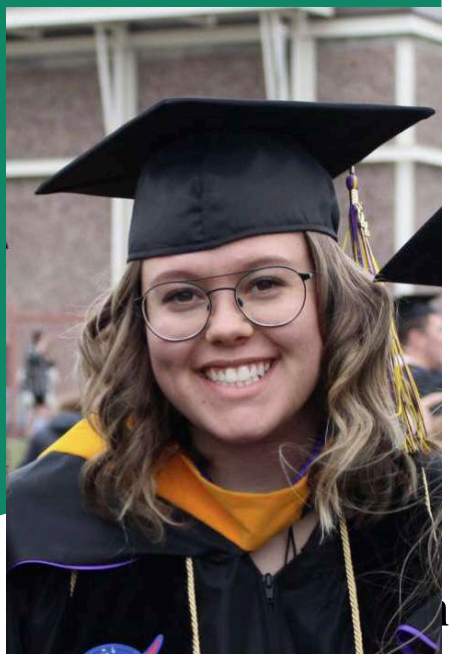
Abstract

In this review, we present a comprehensive mechanism-based overview of sensors engineered for AEDs monitoring, covering design methods and assay techniques. The presented approaches utilized cutting-edge materials, including graphene and 3D carbon structures, gold nanoparticles, quantum dots, and metal-organic frameworks (MOFs), to achieve sensitive and selective detection in various bodily fluids, such as brain interstitial fluid, blood, sweat, urine, saliva, and exhaled breath condensate. Exploring key areas of AEDs sensing could not only advance understanding and

monitoring of therapeutic responses and provide comprehensive insights into brain injury, but also offer a new perspective on AEDs management. Incorporating these sensing platforms into AEDs management systems could facilitate real-time dose adjustments and efficacy monitoring, ultimately improving seizure risk assessment.

Biography

Vaibhav Thirumalai is a second-year undergraduate student at Case Western Reserve University in Cleveland, Ohio. He is attending this conference as a part of Case Western's Biochemistry Research Honors Program. From Bangalore, India, he has been working under Dr. Mohamed Draz at University Hospitals for 18 months, over the course of which he has contributed to several active projects including a recently accepted publication at Trends in Analytical Chemistry, becoming a valued member of the lab.



Annika R. Bergstrom
Villanova University, USA

d Nuclear Localization of Biomimetic Proteoglycans

Abstract

Osteoarthritis (OA) is a progressive joint disease, hallmarked by articular cartilage breakdown and loss of proteoglycans. In early OA, stressors, such as mechanical loading, inflammation, and oxidative stress disrupt chondrocyte homeostasis, leading to organelle dysfunction, increased reactive oxygen species, and catabolic enzymes that degrade the extracellular matrix (ECM) beginning with the immediate microniche of the cell, the pericellular matrix (PCM). Our laboratory has shown the ability to molecularly engineer and modulate the biochemical properties of PCM and territorial-ECM using our group's suite of synthesized biomaterials, biomimetic proteoglycans (BPGs). BPGs are composed of natural chondroitin sulfate bristles (CS) and a poly(acrylic acid) (PAA) backbone that mimics the nano-architecture and water uptake of native proteoglycans. Our most widely studied BPG, BPG10, is a ~250 kDa mimic with ~7-8 CS bristles attached onto a 10 kDa PAA core, and has been shown to passively diffuse through cartilage zones in vivo and ex vivo, while preferentially localizing within the PCM and territorial-ECM. Additionally, previous non-viable tissue studies suggest potential cellular uptake of BPGs. Thus, this study sought to determine (1) if BPGs can be cellularly uptaken and, if so, (2) where BPGs localize within a specific organelle at different dosage concentrations. Confocal imaging and imaging flow cytometry were utilized to determine the uptake of BPG10 fluorescently labeled with Cy5.5 in C28/I2 human chondrocytes and to what organelle BPGs localize within. Confocal imaging and z-stack videos confirmed cellular uptake (Fig. 1a) and localization within the nucleus following 24 h (Fig. 1b) at all dosage concentrations (2.5, 5.0, and 10.0 mg/mL BPG-Cy5.5). Imaging flow cytometry showed significant overlap between

percent BPG-Cy5.5 and the nucleus at 2.5, 5.0, and 10.0 mg/mL after 48 and 72 h compared to untreated controls (Fig. 2a-c), with mean uptake of 73% ± 19%, 80% ± 36%, and 89% ± 19% at 48 h, respectively. This study demonstrated that BPGs not only preferentially localize in the PCM, but also enter and localize within the nuclei of chondrocytes for at least 72 h following BPG application. Taken together, these findings point to a novel use of BPGs as an intracellular vehicle for targeted repair of degenerative articular cartilage that will subsequently inform our understanding of the mechanism of action of BPGs for targeted repair of OA and other disease scenarios.

Biography

Annika Bergstrom is a PhD candidate in Chemical and Biological Engineering at Villanova University, specializing in the interaction between novel biomaterials and tissue regeneration. Her research focuses on how Biomimetic Proteoglycans (BPGs) can modulate the biological outcomes of degraded cartilage through a comprehensive strategy integrating metabolic pathway analysis, protein evalulation, and gene expression studies. Annika employs multidisciplinary molecular engineering approaches to develop and characterize BPG-based drug delivery systems, contributing substantially to the understanding and treatment of cartilage degeneration and osteoarthrtis. She is an author of peer-reviewed publications, an inventor on a biomaterials-related patent, and an international presenter, with technical expertise in metabolomics, molecular assays, and comparative tissue profiling.

Valerie Lallo
Villanova University, USA

Optimizing Polymer Nanoparticle-Mediated Nucleic Acid Delivery and Endosomal Escape for Inhibition of Endothelial Inflammation

Abstract

Endothelial cells (ECs) are an important target for immunomodulation, as they have a large role in mediating inflammatory responses. Silencing inflammatory signaling pathways in endothelial cells, using siRNA, is a strategy to reduce inflammatory activity in a regionally specific tissue. The timing and duration of this activity is important to therapeutic outcomes. We have developed a nanoparticle (NP) delivery vehicle that can control these two metrics. Here, we present a method to track the endosomal escape (EE) of these NPs and tie it to dynamic silencing of the Tumor Necrosis Factor Alpha Super Family 1A (TNFRSF1A) gene.

We developed a high throughout NP tracking method through live fluorescence imaging by transfecting ECs with a GFP-tag to the Rab5A protein on early endosomes and an RFP-tag to the LAMP1 protein on lysosomes. Five polymer NPs with different chemical properties were formulated containing Cy5-dsDNA. Fluorescence imaging tracked NPs in the same cells over 48 hours. Using MATLAB, various metrics were quantified from the images (nα200 images per timepoint, per NP), most notables colocalization of NPs with endosomes and lysosomes. In this same fluorescent cell population, we also isolated the fluorescent endosomes and lysosomes from the HUVECs. The fluorescence on the vesicles and internalized NPs was analyzed via flow cytometry to confirm the imaging data.

The same five NPs from the imaging methodology were formulated containing siRNA for TNFRSF1A, instead of Cy5-dsDNA. These NPs were delivered to non-fluorescent

ECs and the TNFRSF1A expression was measured via qPCR at corresponding timepoints. To further link NP location with therapeutic activity, the inhibition of the TNFα inflammatory cascade by the siRNA was measured via flow cytometry detection of a downstream adhesion molecule present on endothelial cells after activation, E-selectin.

The dynamics of NPs correlated location and concentration in the cells with knockdown activity. Of the metrics collected, the highest NP area in the cell, as well as increases in free NPs at 48hrs, meaning no colocalization with endosomes or lysosomes, seemed to correlate with more robust knockdown and inhibition of the inflammatory pathway in ECs. Two of the four NPs that showed cellular uptake showed decreases in the colocalization of NPs with both lysosomes and endosomes between 4 and 18 hours as well as decreases in free NPs over the course of the 48 hours, suggesting earlier EE in these NPs. The NPs that showed more continuous, or longer, EE also showed more sustained gene knockdown as well as more sustained and increased blockage of the TNFα pathway. Additionally, the NPs that showed the greater cellular uptake, also showed a greater magnitude of TNFRSF1A gene knockdown.

These data indicate that this imaging methodology can accurately track the endocytic pathway of different polymer NPs, revealing the timeline, magnitude, and differences of the EE. Additionally, some NPs showed notable and sustained gene knockdown as well as downstream inhibition of the inflammatory cascade in ECs. These data suggest promising therapeutics for dysfunctional endothelial cells and intercepting inflammation. In future studies, delivery of these same NPs will be explored in a human ex vivo perfusion system, using donated umbilical cords, to discern their cell trafficking dynamics in a more physiologically relevant model.

Biography

Valerie Lallo is a third-year PhD student of Biological and Chemical Engineering at Villanova University. She earned her master's and bachelor's degrees at Widener University in biomedical engineering. She does research in cell and gene therapy, immunomodulation, and drug delivery. She has also recently won second place and people's choice award in Villanova University's 3MT competition.

Navid Tavoosi
McGill University, Canada

Enhancing Granular Hydrogel Stability via Surface Modulation for Improved Frictional Inter-Particle Interactions

Abstract

Introduction

Granular hydrogels have gained significant attention in tissue engineering and bioprinting due to their shear-thinning and self-healing properties, along with their tunable porosity [1]. These hydrogels, composed of microgel particles larger than 10 microns, rely primarily on frictional interactions for structural integrity [2]. Traditional methods to enhance these interactions, such as interparticle cross-linking [3] or embedding microgels in a hydrogel matrix [4], often add complexity or compromise porosity. In this study, we introduce a phase separation-induced surface modulation technique to improve the interconnectivity of porosity and frictional interactions between microgels, enhancing the mechanical stability of granular hydrogels.

Materials and Methods

Microgels were fabricated using a water-in-oil batch emulsion method with a precursor solution consisting of 10% w/v poly(ethylene glycol) diacrylate (PEGDA), 5% w/v poly(ethylene glycol) (PEG), and 0.4% w/v lithium phenyl-2,4,6-trimethylbenzoylphosphinate (LAP). Photopolymerization was performed at 405 nm, and microgels were isolated via centrifugation and multiple washes to remove residual oil. The PEG was then leached out via controlled washing, inducing phase separation to create porous microgels with increased surface roughness. A control group without PEG was fabricated under similar conditions for comparison.

Results & Discussion

The phase separation technique successfully enhanced the surface roughness and porosity of the microgels. Rheological tests showed a 200% increase in viscosity at low shear rates (235 to 705 Pa•s) while maintaining shear-thinning behavior. Additionally, storage modulus doubled during cyclic strain tests, indicating improved self-healing capabilities. The yield strain remained stable at approximately 20%, with a slight increase in PEG-leached samples, suggesting that the enhanced roughness facilitated stronger interparticle friction.

Injectability and printability tests using a 27G needle revealed that the modified hydrogel formed thinner fibers upon extrusion, while contact angle measurements showed improved stacking stability, preventing layer merging under gravitational forces. These results suggest that phase separation-induced porosity interconnectivity enhances frictional interactions between microgels, improving hydrogel structural integrity.
The findings highlight the effectiveness of phase separation in modulating microgel surfaces for improved mechanical stability. By increasing microgel roughness and porosity, frictional forces are enhanced, strengthening interparticle interactions without the need for additional cross-linking agents. This approach maintains the intrinsic advantages of granular hydrogels, such as tunable rheology and self-healing behavior, while improving printability and injectability.

Conclusions

This study demonstrates that phase separation-induced surface modulation is a viable strategy to enhance the mechanical stability of granular hydrogels. The improved interparticle friction achieved through increased porosity and roughness leads to better print fidelity and shape retention, making this technique promising for advanced tissue engineering applications.

Biography

Navid Tavoosi is a biomedical-focused mechanical engineer and MSc researcher at McGill University, specializing in hydrogel-based biomaterials and bioprinting. His current work develops porous granular hydrogels to improve vascularization and mechanical stability, combining microfluidics, emulsion techniques, and advanced characterization methods. At VascuBio Innovation Inc., he integrates real-time sensors into microcontroller-based bioreactor systems for long-term monitoring of bioprinted constructs. Navid's expertise bridges engineering and biology, with a focus on designing functional biomaterials and scalable platforms for regenerative medicine and organoid modeling.

Dr. Peyman Karami
Institute of Bioengineering, School of Engineering, Switzerland

An adhesive hydrogel enabling suture-free cell delivery across osteochondral tissues

Abstract

Failure at the repair–host interface remains a major limitation in cartilage and osteochondral repair, where insufficient mechanical fixation leads to poor contact and incomplete integration before new matrix formation. Current fixation strategies used in advanced cellular therapies such as sutures, press-fit constructs, or fibrin glues do not provide the immediate and durable stability required for long-term tissue integration. Existing hydrogel-based cell carriers improve biological delivery but lack adhesion to surrounding cartilage and subchondral bone. Consequently, there remains no clinically viable material that unifies strong multi-tissue adhesion, mechanical tunability, and reproducible performance in a single injectable system. We developed MechaGel, a light-activated, intrinsically adhesive hydrogel designed as an in situ fixation and cell delivery platform. Unlike previous adhesives optimized for either tissue bonding or cell encapsulation, MechaGel combines both functions within one photopolymerizable formulation suitable for clinical handling. The study quantified its adhesion on human osteochondral tissues, examined formulation-dependent fixation behavior, and evaluated its reproducibility for translational readiness. Hydrogels (5–20 wt%) were photocured and tested for their bulk mechanical properties, lap-shear strength, and tensile adhesion on human cartilage, subchondral plate, and cancellous bone, and were compared with fibrin glue. Furthermore, the effects of polymer concentration, batch variation, and sterilization were systematically analyzed. Ex vivo human tibial plateaus were used to evaluate hydrogel–tissue contact under dry and wet conditions, and to assess precursor penetration into cancellous bone in separate large-defect models. Our hydrogel exhibited tunable cohesive and adhesive properties with

negligible batch variability. Adhesion consistently exceeded that of fibrin glue across all tissues (~5 times higher). Sterilization reduced the properties but preserved both mechanical and adhesive performance within clinically relevant ranges. Moreover, the controlled polymer concentration determined whether the material partially infiltrated or remained confined within the cancellous bone. These results demonstrate that our hydrogel system presents reproducible and quantifiable fixation across osteochondral tissues, as a suture-free fixation and cell delivery platform for reliable cartilage and osteochondral repair.

Biography

Dr. Peyman Karami is a Research Associate and Project Leader in the Department of Orthopedic Surgery and Traumatology at the University Hospital of Lausanne (CHUV), and a Visiting Scientist at EPFL (École Polytechnique Fédérale de Lausanne). He obtained his PhD in Materials Science and Engineering from EPFL in 2021, followed by postdoctoral research at the Laboratory of Biomechanical Orthopedics. His research focuses on bridging material innovation with biomedical applications through biomaterials design and characterization, preclinical validation and clinical translation. He has authored over 25 peer-reviewed publications in biomaterials and tissue engineering, led several funded research projects supported by the Swiss National Science Foundation, Bridge PoC, Innogrants, and Innosuisse, and serves as a reviewer for several leading journals in biomaterials and regenerative medicine. His current research aims to advance adhesive hydrogel technologies toward clinical use in cartilage and osteochondral repair.

Mrs. Priyanka Chaturvedi
Jai Narain College of Pharmacy, India

Arteether Nanoemulsion for Enhanced Oral Efficacy Against Plasmodium yoelii nigeriensis: A Bioavailability-Driven Approach

Abstract

Arteether (ART) is a potent antimalarial drug, but its clinical utility is limited due to low aqueous solubility and poor oral bioavailability. This study aimed to develop an ART-loaded nanoemulsion (ART-NE) to improve systemic exposure and antimalarial efficacy against Plasmodium yoelii nigeriensis in a murine model.

Methods:
ART-NE was prepared via high-pressure homogenization, optimizing the ratio of oil, surfactant, and co-surfactant. The formulation was characterized for droplet size, zeta potential, drug-loading efficiency, and in vitro release. Pharmacokinetics were assessed in rats after oral administration. For efficacy, infected Swiss mice were treated with ART-NE (12.5 mg/kg, once daily × 5 days) and compared with ART in conventional oil and intramuscular ART.

The optimized nanoemulsion exhibited a mean droplet size of 148 ± 8 nm, zeta potential of –25.1 ± 2.9 mV, and a loading efficiency of ~90%.In vitro release studies showed a sustained release of ~58% of ART over 12 hours.Pharmacokinetic data in rats revealed a 3.1-fold increase in oral bioavailability for ART-NE versus ART in oil ($AUC_{0–t}$ ≈ 2,070 h•ng/mL, C_{max} ≈ 1,440 ng/mL).

In the mouse malaria model, ART-NE achieved a ~78% cure rate, compared to ~28% for the conventional oral formulation, and the efficacy was nearly comparable to 100%

survival with intramuscular ART.The developed ART-nanoemulsion significantly enhances the oral bioavailability and therapeutic efficacy of arteether in malaria. This non-injectable formulation could provide a patient-friendly alternative to parenteral ART, with the potential to improve treatment outcomes.

Biography

I am a postgraduate researcher in the Department of Pharmaceutics at Jai Narain College of Pharmacy, JNCTPU, Bhopal, India. Her research focuses on novel drug delivery systems, nanoemulsions, lipid-based formulations, and strategies to enhance the bioavailability of poorly soluble drugs. I have extensive hands-on expertise in formulation development, advanced characterization techniques, and in vivo evaluation studies. She has successfully guided M.Pharm students in their research projects, fostering academic excellence and innovation. I have published research papers in SCI-indexed journals and presented her work at national and international conferences. Her research emphasizes improving therapeutic efficacy through advanced pharmaceutical technologies and surface modification strategies for targeted drug delivery. She actively participates in faculty development programs and scientific event organization. With strong academic commitment and research aptitude, she aims to contribute significantly to translational pharmaceutics and the development of patient-centric drug delivery systems.I have received grant From MPCST -BHOPAL for IPR.

Dr. Venkadeswaran Karuppasamy
India

Stem Cell Therapy in Regenerative Medicine: Advances, Applications, and Future Perspectives

Abstract

Stem cell therapy has emerged as a transformative field in regenerative medicine, offering promising solutions for repairing, replacing, or restoring damaged tissues and organs. Stem cells possess unique properties of self-renewal and differentiation, enabling them to generate specialized cell types and support tissue regeneration. Advances in embryonic stem cells, induced pluripotent stem cells (iPSCs), and adult stem cells have broadened therapeutic possibilities across various medical disciplines. Current applications include the treatment of hematological disorders through bone marrow transplantation, regeneration of cardiac tissue following myocardial infarction, and repair of neural damage in conditions such as spinal cord injury and neurodegenerative diseases. Additionally, stem cell–derived organoids and engineered tissues are revolutionizing drug testing, disease modeling, and personalized medicine. Despite significant progress, challenges remain concerning immunological compatibility, ethical considerations, tumorigenicity, and standardization of clinical protocols. Continued research, clinical trials, and technological innovation are vital to unlocking the full therapeutic potential of stem cells. Overall, stem cell therapy represents a rapidly evolving frontier with the potential to reshape modern healthcare and improve the quality of life for patients with currently incurable conditions.

Keywords:
Stem Cell Therapy, Regenerative Medicine, Induced Pluripotent Stem Cells (iPSCs), Tissue Regeneration, Clinical Applications, Personalized Medicine.

Dr. Priyanka Chhabra
Amity University Noida, India

Enhanced in vivo Chronic Full-Thickness Wounds healing with Antimicrobial Chitosan- Graphene Nanocomposites

Abstract

Chronic wounds present a major challenge for healthcare professionals and have significant socioeconomic impacts globally [1]. In recent years, nanocomposites have emerged as a vital tool in chronic wound treatment due to their ability to deliver antimicrobial drugs topically in a sustained and effective manner [2]. The incorporation of active excipients such as chitosan and graphene oxide during formulation further enhances their potential to promote wound healing.This study focuses on the design, fabrication, and evaluation of antimicrobial-loaded chitosan-encapsulated graphene nanoparticles (AN-CH-G-NPOs) aimed at accelerating wound healing [3,4]. Specifically, a gel formulation containing encapsulated rosmarinic acid and iodine-chitosan graphene oxide nanocomposites was developed with a comprehensive evaluation to discern its potential in augmenting the in vivo wound healing trajectory for full thickness chronic wounds. The prepared rosmarinic acid and iodine nanocomposites demonstrated enhanced antibacterial activity, with minimum inhibitory concentrations of 0.0038 ± 0.2 mg/mL and 0.00513 ± 0.00014 mg/mL, respectively, against gram-positive Staphylococcus aureus. Additionally, in vivo wound healing efficacy was evaluated using Sprague-Dawley rats, revealing a significant increase in wound contraction rates of 98.78 ± 2.2% and 99.89 ± 2.2% for rosmarinic acid and iodine nanocomposites respectively. Histopathological analyses revealed significant improvements in wound contraction, cell adhesion, epithelial migration, and hydroxyproline content, indicating enhanced collagen synthesis. These findings highlight the potential of these nanocomposite-based gels as an innovative therapeutic strategy for chronic wound management.

Keywords:
Nanocomposites, Rosmarinic acid, Iodine, Graphene oxide, chitosan, wound healing.

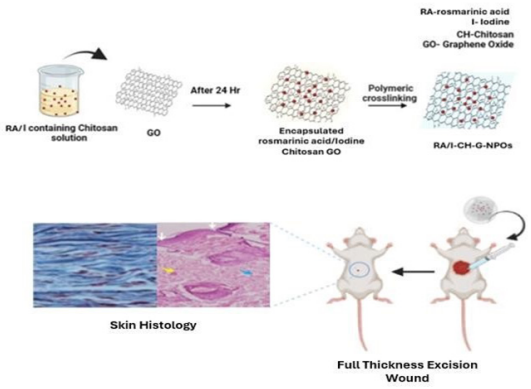


Fig 1: Schematic Representation of Nanocomposite formation and In Vivo Wound Healing Application in an Excision Rat wound model

Biography

Dr. Priyanka Chhabra specializes in biomaterials, focusing on the synthesis and characterization of biopolymeric scaffolds and hydrogels for chronic, burn, and diabetic wounds. She has developed silk nanoparticle-loaded gelatin and alginate nanocomposites for burn wound healing and a hydrogel for scar-free diabetic wound treatment using a unique combination of bioactive agents.

Her work also includes rosmarinic acid and iodine-loaded chitosan-graphene nanopockets for chronic wound healing. She optimizes and evaluates chitosan-based scaffolds for tissue engineering and wound repair. Additionally, she has studied the efficacy of chitosan gel formulations compared to conventional treatments and assessed their skin permeation using radiometry and gamma scintigraphy.

Dr. Chhabra joined Amity Institute of Biotechnology, Amity University, Noida, as an assistant professor in 2022. Before that, she was an assistant professor at the School of Basic and Applied Sciences, Galgotias University, Uttar Pradesh. Dr. Chhabra completed her doctoral studies in 2018 under the mentorship of Dr. Amit Tyagi, Scientist F at INMAS, DRDO. She then pursued postdoctoral research with Dr. Jayanta Bhattacharya at the Center for Biomedical Engineering, IIT Delhi and published in excess of 20 papers in rumored journals.

Menaga.S
Vellore Institute of Technology, India

Extrusion based multifunctional 3D printed scaffold for wound healing application

Abstract

Skin regeneration post injury is a complex physiological process and thus remains as a major clinical challenge. 3D printing is an emerging technology which enables the fabrication of complex intricate tissue structures and models 1. Therefore, in recent decades fabrication of innovative scaffolds and 3D printed dressings are emerging and promising strategies to accelerate wound healing2. In this study, a multifunctional 3D printed patch was fabricated using an extrusion-based 3D printing technolsogy with two natural polymers viz., alginate, Kappa carrageenan and infused with nanoparticles. The nanoparticles were synthesized through chemical method and were found to be around <200 nm in size. The obtained nanoparticle size can be beneficial towards improved tissue penetration, effective clearance and improved antibacterial activities. The 3D printing ink was optimized and analysed for their swelling, degradation, rheological, mechanical, anti-bacterial and cytocompatibility with NIH3T3 cells. By adjusting the ratio of alginate and kappa carrageenan, the printability, mechanical strength, swelling capacity, and degradation rate was improved and conferred multifunctional capability to the 3D printed scaffold. The scaffold had improved shape fidelity, rigidity, showed sustained swelling ratio, slow degradation rate, cell adhesion and were cyto-compatible. Moreover, the scaffold showed significant potential for wound healing, tissue regeneration, and can be encouraging towards transdermal therapeutic delivery. This work highlights the synergistic integration of natural polysaccharides with nanoparticles for precision-engineered, patient specific and adaptive solution towards biomedical applications.

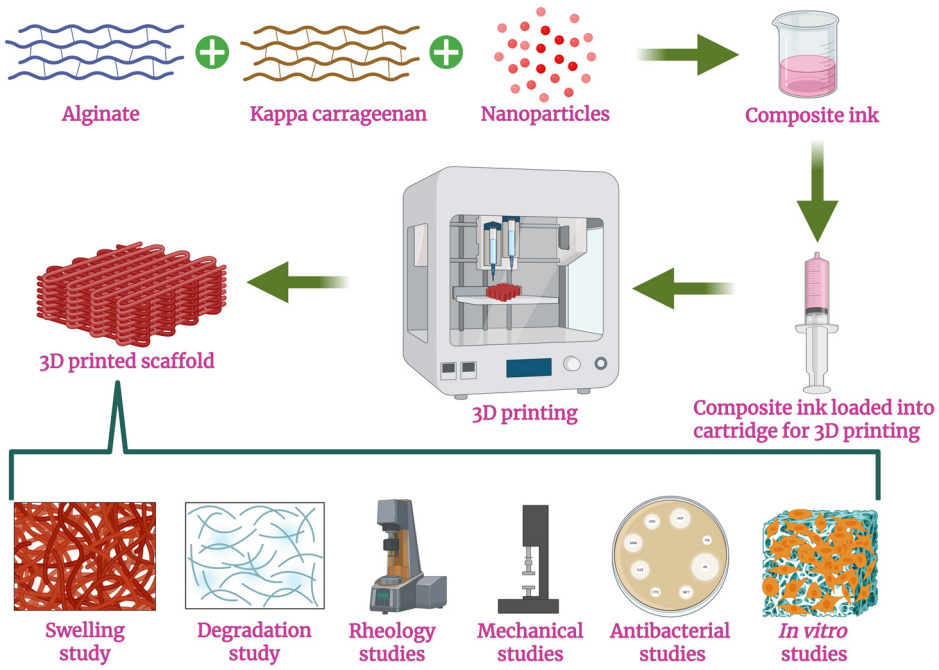


Figure 1: Schematic of the extrusion based multifunctional 3D printed scaffold for wound healing application

Biography

I am Menaga. S holding undergraduate, postgraduate, and M.Phil. degrees in Zoology. Currently pursuing my PhD at the Vellore Institute of Technology (VIT), Vellore, Tamil Nadu. My research area of interest focuses on the chemical functionalization of polymers and their applications in advanced biomedical systems, and my expertise includes 3D printing, 3D bioprinting, and the development of polymeric films and transdermal patches for tissue engineering and therapeutic delivery. Through this interdisciplinary work, I aim to integrate principles of biology, chemistry, and materials engineering to design innovative, biocompatible materials that enhance clinical outcomes. I have authored 2 book chapters with chapter as "Bioprinting of skin" in the book entitled "Bioprinting: Artificial intelligence, Biomaterials, cells and tissues" under De Gruyter press, Germany and another chapter entitled as "Clinically Used Hydrogels for Biomedical Applications" in the book entitled "Hydrogel tissue analogues" under Elsevier publication, and papers based on my research work will be published soon.

Mr. ADIL USMAN
Pakistan

Adsorptive performance of green-synthesized ZnO nanoparticles: RB-5 dye removal, kinetics, and antioxidant evaluation for environmental and biomedical applications

Abstract

Nanotechnology provides significant solutions to challenges across various fields, including biomedicine, environmental remediation, and catalysis. Zinc oxide (ZnO) nanoparticles have garnered considerable attention due to their applications in biomedical and photocatalysis. This study used a green method to synthesize ZnO nanoparticles using Euphorbia granulata leaf extract. The synthesized nanoparticles demonstrated a removal efficiency of up to 94.05% for the reactive black-5 dye at a concentration of 50 ppm over 260 min under sunlight. The maximum DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging activity of ZnO nanoparticles was 64.4% at 100 μg/mL concentration. Adsorption process of biosynthesized ZnO nanoparticles was supported by kinetic (pseudo-second-order) and isotherm (Freundlich) models (R^2 = 0.99). This work presents an eco-friendly method for synthesizing ZnO nanoparticles and evaluating their applications in biomedical and photocatalytic fields.

Bijay Kumar Karali
Indian Institute of Science, India

Asymmetric mechanical behavior and pre-osteoblast differentiation in Ti6Al4V minimal-surface bone-analogues: the role of pore topology

Abstract

Replicating bone's complex architecture in additively manufactured implants remains a critical challenge for ensuring biomechanical compatibility. This study investigates how a hierarchical design philosophy, validated by advanced characterization, can be used to fabricate Ti6Al4V scaffolds that successfully biomimic cortical bone. We fabricated Schwarz diamond-based TPMS structures via laser powder bed fusion and employed extensive micro-computed tomography (micro-CT) to create detailed pore network models and assess manufacturability. The resulting scaffolds successfully met our primary criterion, exhibiting a compressive strength of 413–547 MPa and an elastic modulus of 14–20 GPa, closely matching cortical bone. They also achieved the desired hybrid structure with low porosity (24–37%) and large pores (689–935 μm), which supported robust cell adhesion and osteogenic maturation. This work validates a methodology for producing mechanically optimized, biocompatible structures with significant potential for load-bearing reconstructive surgeries.

Biography

Bijay Kumar Karali is a metallurgist by training, holds B.Tech and M.Tech degrees in Metallurgical and Materials Engineering. He is now a Ph.D. student at the Indian Institute of Science (IISc), Bangalore, in Prof. Bikramjit Basu's lab, where he has transitioned into the interdisciplinary field of Biomaterials Science. His research focuses on the additive manufacturing of porous Ti6Al4V implants, using micro-computed tomography (Micro-CT) to link pore topology with mechanical and biological performance. His work on TPMS scaffolds establishes key structure–property–function correlations for bone-mimetic materials. Currently, he is a visiting scholar at the University Polytechnique Hauts-de-France, exploring direct ink writing of ceramics. In parallel, he applies machine learning to metal AM, aiming to integrate experimental and data-driven approaches for designing the next generation of load-bearing biomedical implants.

Nilesh R. Bhoi
Indian Institute of Technology Bombay, India

Engineering Bioactive PCL–Nanocellulose–Hydroxyapatite Composites: A MeltProcessed Route to Bioresorbable Orthopedic Fixation Devices

Abstract

The development of bioresorbable fixation devices that combine structural integrity with osteoconductivity remains a significant challenge in orthopedic biomaterials. In this study, poly(εcaprolactone) (PCL) was melt-mixed with nanocellulose (NC) and hydroxyapatite (HA) to fabricate hybrid composites with enhanced mechanical strength, bioactivity, and degradation kinetics suitable for bone screw applications.
Composites were prepared through twin-screw extrusion followed by injection molding into standardized test specimens. The incorporation of NC improved tensile and flexural moduli by reinforcing the polymer matrix, while HA addition contributed to mineral phase integration and surface bioactivity. Morphological analysis by SEM revealed uniform filler dispersion and interfacial adhesion. XRD confirmed the coexistence of crystalline PCL and HA phases without thermal degradation of polymer chains.
In vitro degradation studies in PBS demonstrated controlled mass loss and pH stability, indicating predictable resorption behavior. Cytocompatibility assays (with SaOS-2) showed excellent cell viability, ALP activity, and mineralization, confirming osteogenic potential. The mechanical and biological synergy achieved in the PCL–NC–HA system demonstrates its suitability as a next-generation bioresorbable composite for load-sharing orthopedic fixation devices and resorbable screw prototypes.
These findings advance melt-processed polymer composites toward clinical translation by enabling scalable manufacturing, reproducible properties, and biofunctional performance that bridge the gap between mechanical reliability and biological integration.

Biography

Nilesh R. Bhoi is a doctoral researcher in Chemical Engineering at the Indian Institute of Technology Bombay, working under the supervision of Prof. Jayesh Bellare. His research focuses on developing biodegradable polymer–ceramic composites and multifunctional scaffolds for orthopedic fixation and regenerative applications. His work adopts a solution-oriented approach aimed at translating biomaterials research into clinically meaningful outcomes. By closely consulting orthopedic surgeons and medical specialists, he has identified critical challenges in bone repair, particularly the need for resorbable implants that provide both mechanical support and biological integration. Positioned at the intersection of materials science, biomedical engineering, and regenerative medicine, his research delivers engineering-driven innovations with immediate translational relevance. Through integrating scalable polymer processing, bioactive coatings, and in vivo evaluation, Nilesh seeks to bridge laboratory advances with real-world orthopedic applications to enhance patient recovery and improve long-term outcomes.

Subhankar Maity
Jawaharlal Nehru Centre for Advanced Scientific Research, India

Bioactive Osseointegrative Antimicrobial Coating for Titanium Implants: A facile solution for Cementless Fixation and Infection Prevention

Abstract

Worldwide, more than 10 million people undergo orthopedic implantations like hip replacements, total knee arthroplasties, knee replacements, etc. Poor osseointegration and implant-associated infections are major post-orthopedic surgery issues, causing chronic pain, disability, lengthy recovery, and even revision surgery. This can lead to patient discomfort, and in the worst scenario, it can lead to mortality. Conventional antimicrobial therapies fail due to poor bioavailability and antimicrobial resistance. Market solutions like Silver-loaded Agluna and Gentamycin-loaded Expert tibia nails offer short-term fixes but lack long-term efficacy and fail to address osseointegration. To tackle this, we've developed a multifunctional antimicrobial and osseointegrative coating for orthopedic implants. Our dopamine-conjugated antimicrobial polymer (DQP) is covalently bonded via dip-coating (Ti-DQP), ensuring long-lasting antimicrobial properties. Additionally, we noncovalently added calcium silicate (Ti-DQP-CaSi), which releases calcium locally to boost osteogenesis and speed up bone healing. Ti-DQP-CaSi exhibits excellent antimicrobial efficacy, reducing 106 CFU/mL of bacteria and fungi within 15 minutes, and enhances osseointegration, improving collagen deposition, calcium mineralization, and ALP activity 2-3 times compared to standard titanium implants.

This innovative approach not only prevents infections but also promotes faster and more effective implant integration.

Biography

I am a biomedicine and biomaterials scientist with a future-oriented approach, eager to utilize emerging biomedical engineering to minimize human pain. Motivated by revolutionary breakthroughs, I am now a Ph.D. candidate at JNCASR, Bangalore (since September 2021) in Medicinal Chemistry and Biomaterials. My research aims to design antimicrobial coatings for implant devices to avoid infection and develop nanoparticle-based antimicrobial photodynamic therapies to cure diabetic wound infections.

I possess an M.Sc. in Chemistry from IIT Madras (2018–2020), where I established a strong background in analytical and synthetic methodologies. Parallel to this, I acquired high levels of proficiency in microbiology, cell culture, and animal experimentation to explore various aspects of biomaterials and bioengineering. I am presently keen on progressing biomedical engineering and regenerative medicine, endeavoring to design innovative, application-focused materials with the potential to leave a lasting, real-world impact on human health.

Subith Cheeyattil
National Institute of Technology, India

EHD techniques for biostabilizing food and functional biomolecules

Abstract

The rising popularity of functional foods, nutraceuticals, and dietary supplements has led to a dramatic increase in the demand for the biostabilization of bioactive peptides, cell cultures, and other functional ingredients. Electrohydrodynamic (EHD) processing—including drying, encapsulation, and immobilization—is emerging as a sustainable, next-generation solution for preserving these bioactives and enhancing their stability. This review examines the impact of various EHD technologies on product stability under diverse processing and environmental conditions. It analyzes explicitly how electric fields influence the chemical properties, molecular structure, and structural integrity of biomolecules. Furthermore, the literature discusses various polymers and encapsulation matrices, focusing on their compatibility and effect on the stability of encapsulated materials. These findings provide a valuable resource for researchers developing nutraceuticals, probiotics, and tissue engineering applications. EHD drying is shown to preserve the functional and nutritional value of principal components without degradation. Additionally, EHD encapsulation offers superior stability and structural integrity compared to conventional techniques. Notably, advanced coaxial EHD encapsulation has been found to enhance microbial cell culture viability and improve in vitro release kinetics. Finally, EHD inkjet printing demonstrates immense potential in fields such as tissue engineering, scaffolding, cultured meat production, biosensing, and active packaging.

Biography

Subith Cheeyattil is pursuing his PhD from the National Institute of Technology Rourkela (NIT Rourkela). He is a researcher specializing in Electrohydrodynamic (EHD) drying techniques, with a focus on biostabilization. His technical expertise extends to nonthermal technology, EHD drying, encapsulation, and 3D printing. He has published research papers in reputed journals, contributing significantly to the development of novel food processing and preservation methodologies

Madhulika Narayan
India

High-strength biocompatible implant for fracture fixation

Abstract

Orthopedic fixation pins are critical load-bearing devices for fracture stabilization and alignment. Conventional metallic systems, though mechanically robust, exhibit a pronounced modulus mismatch with bone, resulting in stress shielding, localized osteolysis, and imaging artefacts. Conversely, bioresorbable polymers lack the requisite mechanical strength for cortical fixation and often release acidic by-products upon degradation, which can lead to inflammatory reactions. PEEK is unique among biomaterials as it possesses a cortical bone-like modulus and therefore, flexes and bears weight like bone. This mitigates the occurrence of stress shielding and allows PEEK spinal cages to integrate well into the fusion site while preserving the integrity of the neighboring bone. However, its intrinsic hydrophobicity and biological inertness hinder osteoconduction.

In this work, PEEK granules were injection-molded at 390 degrees using a custom-designed mold to fabricate cylindrical fixation pins (3 mm diameter × 80 mm length), followed by controlled sulfonation for (1,3, and 5 minutes) at room temperature to generate sulfonated PEEK (sPEEK) with a microporous and chemically reactive surface. Subsequently, a gelatin–bioglass hybrid coating was applied via dip-coating, enabling covalent anchoring to the sulfonated matrix. SEM analysis confirmed a uniform, adherent coating morphology without surface defects. Mechanical testing revealed a bending strength of 160 MPa and a modulus of 4 GPa, indicating that surface modification and coating did not compromise the bulk integrity of PEEK. In-vitro proliferation studies using osteosarcoma cells demonstrated enhanced cell attachment and growth on sPEEK, further amplified following hybrid coating. Hemocompatibility assays (ASTM F756) confirmed hemolysis levels below 5%, signifying excellent blood compatibility. Alizarin Red S quantification indicated up to 1.8-fold higher mineral

deposition after 7 days for the modified and coated surfaces compared to pristine PEEK, evidencing superior osteogenic potential.

Collectively, the sulfonation-assisted gelatin–bioglass functionalization of PEEK produces a bioactive, hemocompatible, and mechanically resilient fixation pin with the requisite characteristics for load-bearing orthopedic applications and enhanced osseointegration.

Ms. Afra Samreen
Rajiv Gandhi University of Health Sciences, India

BioDentX: Bio-Intelligent Self-Healing Dental Biomaterial for Enamel Regeneration

Abstract

Aim or Purpose
To develop a next-generation self-healing dental biomaterial that enables true enamel regeneration by combining controlled bioactive ion release, biomimetic peptides, and a supportive adhesive matrix, with the long-term goal of preserving natural tooth vitality in high-caries populations.

Materials and Methods
BioDentX is designed as a hybrid regenerative system comprising: (1) bioactive glass particles providing sustained release of calcium, phosphate and fluoride ions to drive remineralisation; (2) specialized biomimetic peptides that promote enamel-like mineral nucleation and early dentin matrix support; and (3) a smart adhesive polymer scaffold that secures the restoration while maintaining a moist, pro-regenerative microenvironment at the tooth–material interface. Design feasibility has been evaluated at Technology Readiness Level 2 using conceptual modelling, material-interaction assessment and ion-release profile planning, focusing on minimally invasive clinical application.

Results
Early conceptual and theoretical evaluations indicate that BioDentX could reverse early enamel demineralisation, enhance mineral recovery and improve long-term stability compared with conventional inert restorative materials. By favouring remineralisation over bulk removal of tooth structure, the system is intended to decrease restoration

failure, delay the restorative cycle and support vitality-based dentistry, especially in high-caries-risk settings.

Conclusions

BioDentX represents a bio-intelligent restorative concept that shifts dentistry from purely “drill and fill” towards a “heal and seal” model, where teeth regain partial self-repair capability through biomimetic materials. Planned invitro studies, including ion-release testing, microhardness recovery and simulated caries models, will be used to validate regenerative performance and support future translational studies.

Achievements

Awarded Second Place at the Manipal BioIncubator National BioInnovation Hackathon for innovation and translational potential.

Keywords

Regenerative dentistry; self-healing biomaterial; enamel remineralisation; biomimetic peptides; bioactive glass; smart adhesive scaffold.

Ms. Antara Poi Raiturker
Birla Institute of Technology and Science, India

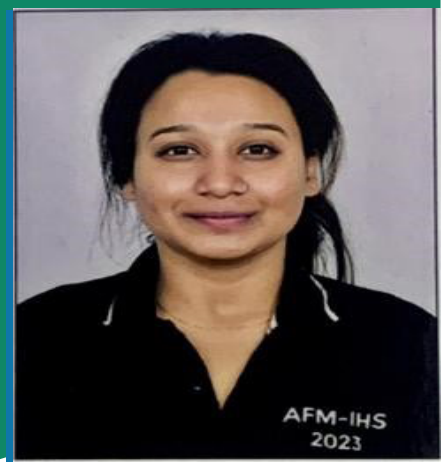
Exploring the Potential of Alginate-Starch based Bioink Composites for Soft Tissue Engineering using 3D Bioprinting

Abstract

There is a need to develop cost-effective and biocompatible bioinks for 3D bioprinting of soft tissues. Our study explores the potential of a composite bioink formulated from sodium alginate and partially pre-gelatinized starch for supporting the bioprinting of soft tissues. The formulations were optimized using sodium alginate & starch as the base polymers for the bioink and it was bioprinted using extrusion-based 3D bioprinting. The stability and structural integrity of the printed tissue constructs were assessed in vitro using parameters like viscosity, printability, mechanical integrity, cytocompatibility and hemocompatibility. The studies showed excellent shear thinning behaviour with yield stress range suitable for extrusion-based bioprinting. The biocompatibility of the composite hydrogel was assessed using HeLa cells. MTT assay showed cell viability of more than 90% and the cells were able to thrive in the bioink for longer time periods post-printing. Furthermore, the composite hydrogels demonstrated controlled degradation, enhanced porosity and favorable swelling behavior, essential for nutrient diffusion and tissue remodeling. Overall, the alginate–starch composite bioink presents a promising, low-cost and tunable platform for soft tissue engineering applications such as skin, cartilage and cancer-organoid models. This work contributes to the everexpanding research in sustainable biomaterials and supports further exploration of plant-based bioinks in regenerative medicine.

Biography

Ms. Antara Poi Raiturker has completed her Masters in Zoology from Goa University. In the past, she has worked on projects focussing the assessment of cytotoxicity of nanomaterials on fish derived primary cell lines & human cell lines etc. She is a doctoral graduate student in the Department of Biological Sciences, Birla Institute of Technology and Science, Pilani (BITSPilani), doing her PhD in the field of tissue engineering from. Her research focusses on the developent of bioink for skin tissue engineering and its applications in the biomedical field to treat chronic wounds and burns.



Dipanjana Patra
Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), India

Harnessing Antimicrobial Superhydrophobic Biomaterials for Subsiding Urinary Tract Infections and Improving Women Health

Abstract

The recurrence of drug-resistant pathogens from lesions and infections such as catheter associated urinary tract infections (CAUTI), bacterial vaginosis poses significant challenges. They remain prevalent, recurrent, and challenging to treat due to persistent bacterial reservoirs and biofilm formation. Similarly, menstrual hygiene products, if improperly sterilized, can facilitate microbial colonization, leading to severe infections, including those caused by drug-resistant pathogens like toxic shock syndrome (TSS). Conventional approaches, such as antibiotic-impregnated surfaces, often result in uncontrolled release and antimicrobial resistance. To address these challenges, we developed a non-covalent superhydrophobic coating on silicone-based surfaces, including urinary catheters and menstrual cups, to inhibit pathogen adhesion and biofilm formation. The coating, composed of quaternized polyethyleneimine (P16) and graphene oxide (GO), leverages the strong interactions between the hydrophilic moieties of both components to induce the formation of hydrophobic aggregates, imparting remarkable fluid repellence. The engineered surfaces effectively prevented adhesion of drug-resistant Gram-positive and Gram-negative bacteria, including uropathogenic Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, Proteus mirabilis, Enterococcus faecalis, and Candida species.

Superhydrophobicity was validated under dynamic and static conditions, demonstrating sustained repellence against bodily fluids. Biocompatibility was confirmed through

in-vitro and in-vivo assessments, and the bactericidal efficacy was validated using a murine intravaginal infection model. This novel coating offers a broad-spectrum, non-antibiotic-based strategy to mitigate recurrent urogenital infections, presenting a significant advancement in infection-resistant biomedical materials.

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3. Flores-Mireles et al. Nat Rev Microbiol.,2015,13,269
4. Ensign et al. Sci Transl Med. 2012, 4, 138ra79.

Biography

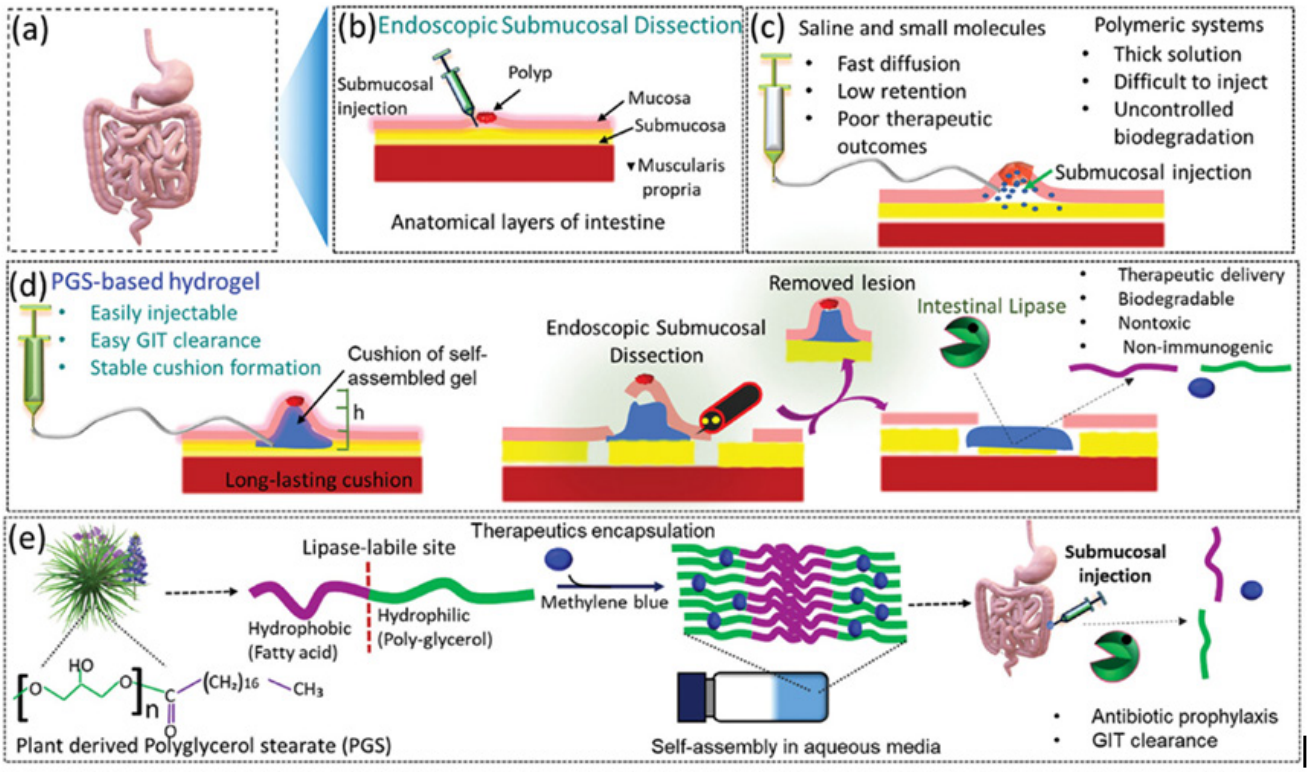
I am in my final year of my PhD in the lab of Prof. Haldar at Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru, India where the main research focus is interdisciplinary approaches for understanding and countering antimicrobial resistance (AMR). My research interests are expansive in the field of designing biomaterials to treat women-health associated infections and diseases. My research involves coatings for biomedical devices like catheters and expands to hygiene products like menstrual cups as well. I am developing hydrogels to tackle local vaginal bacterial and fungal infections. My expertise lies in not only synthesis of such polymeric scaffolds but also in conducting in-vitro as well as in-vivo experiments. I am an extremely enthusiastic individual looking forward to expanding my horizon of knowledge, to learn more about biomedical engineering. I have published 8 articles till date and many for ready for submission with 119 citations.

Ms. Hitasha Vithalani
Indian Institute of Technology, India

Easily Injectable, Organic Solvent-Free Self-Assembled Hydrogel Platform for Endoscope Mediated Gastrointestinal Polypectomy

Abstract

Endoscopic submucosal dissection (ESD) and endoscopic mucosal resection (EMR) are widely employed for removing small, flat gastrointestinal (GI) lesions, but their success depends on creating a durable submucosal cushion. Conventional injectables such as saline and hypertonic dextrose dissipate rapidly, while polymeric agents like gelatin and alginate suffer from poor injectability. Here, we report a novel amphiphilic polyglycerol stearate-based hydrogel (PGSH) that addresses these limitations by enabling smooth catheter injection, shear-thinning behavior, and long-lasting submucosal elevation. PGSH encapsulates hydrophilic drugs (e.g., streptomycin) and supports both enzymatic and non-enzymatic controlled release. Ex vivo studies in goat GI tissue confirmed clog-free injection and stable cushion formation, while blood assays revealed rapid hemostasis with preserved hemocompatibility. In vivo murine studies demonstrated biocompatibility, non-toxicity, and absence of cytokine overexpression, with the hydrogel forming cushions of clinically relevant height. Importantly, porcine ESD trials validated safe injection and effective polyp resection. Collectively, PGSH represents a promising next-generation submucosal lifting agent with drug delivery capability, offering significant potential to improve outcomes in early GI polyp management.



Biography

Hitasha Vithalani is a Ph.D. scholar in the Department of Biological Sciences and Engineering at IIT Gandhinagar, India. She completed her M.Sc. in Biotechnology from The Maharaja Sayajirao University of Baroda. Her research focuses on biomaterials, nanotechnology, injectable hydrogel systems, and targeted anticancer therapy, with applications in drug delivery, cancer theranostics and implant coating. She has published research articles and book chapters in reputed international journals and filed four Indian patents, with one granted. Her work is directed toward translating innovative biomaterial-based strategies into practical healthcare solutions for improved patient outcomes.

Lisha Awasthi
Indian Institute of Technology Bombay, India

A Soft Solution: Spongy Biodegradable Scaffold for Localized Endometriosis Therapy

Abstract

Endometriosis, a chronic estrogen-dependent condition affecting nearly 10% of women of reproductive age, necessitates localized and sustained therapeutic strategies to overcome the limitations of systemic drug administration. Conventional hormonal therapies are often associated with side effects, recurrence, and poor patient compliance, underscoring the need for biomaterialbased platforms that enable controlled and long-term drug release. In this work, a biodegradable spongy scaffold incorporating PLGA microparticles was developed as an innovative system for the sustained local delivery of an aromatase inhibitor. The scaffold was fabricated using optimized formulation parameters and crosslinking to achieve a porous, flexible, and biocompatible matrix capable of maintaining structural integrity during prolonged implantation. Incorporation of PLGA microparticles within the scaffold enabled controlled and extended release of the encapsulated drug through diffusion–degradation coupling, providing a tunable platform for long-term delivery. Preliminary in-vitro and in-vivo assessments demonstrated stable release kinetics, predictable degradation, and favorable pharmacokinetic profiles compared to free drug systems. The biomaterial design highlights the synergy between scaffold porosity, crosslinking density, and polymeric encapsulation in modulating release behavior. Ongoing studies are focused on correlating scaffold architecture with release dynamics and therapeutic outcomes in disease models. This spongy biodegradable scaffold system exemplifies a versatile and translational approach within the field of biomaterials for controlled release, offering a sustained, site-specific, and biocompatible drug delivery strategy that addresses key challenges in the long-term management of endometriosis and potentially other chronic inflammatory disorders.

Biography

Lisha is a research scholar jointly supervised by Prof. Rohit Srivastava (Biosciences and Bioengineering Department, IIT Bombay) and Prof. Jayesh Bellare (Chemical Engineering Department, IIT Bombay). Her research interests include developing novel regional biomaterialbased strategies for the treatment of Endometriosis. Before joining as a PhD program in the Nanobios lab, Lisha enrolled in the Master's in Biotechnology program of IIT Bombay after securing AIR 9 in the JAM exam. Her keen interest in contributing towards women's reproductive healthcare introduced her to the topic. She is passionately committed to enhancing women's health and empowerment through her groundbreaking research. Currently, she is working on transformative women's reproductive healthcare projects funded by the Wadhwani Research Centre for Bioengineering in collaboration with industry partner Pulse Pharma. Her innovative research product prototype has also secured funding from a prestigious Institute of Eminence grant, marking it as a promising startup innovation.

Malika Arora
Institute of Nano Science and Technology, India

Injectable Polysaccharide-Based Composite Hydrogel for Regeneration of Critical-Sized Bone Defects

Abstract

Problem:
Trauma-induced bone injuries, especially critical-sized defects (CSDs), remain a significant clinical challenge due to their inability to heal spontaneously. Existing treatment strategies often suffer from complications such as immune rejection, donor site morbidity, and limited integration with host tissues.
Purpose/Objective:
This study aims to develop a minimally invasive, injectable, and bioactive hydrogel capable of regenerating CSDs. The hydrogel should mimic the extracellular matrix, facilitate mesenchymal stem cell (MSC) differentiation, and support in situ bone regeneration through osteoconductive and osteoinductive signals.

Methodology:
A Schiff-base reaction between carboxymethyl chitosan (CC) and oxidized dextran (D) was employed to create an injectable polysaccharide-based hydrogel. Functionalized nanohydroxyapatite (nHAP) and mesoporous silica nanoparticles (SiNPs) were incorporated to enhance the mechanical and osteogenic properties, resulting in a composite hydrogel (CCD@HapSi). The hydrogel was characterized for gelation time, swelling, degradation, mechanical strength, and self-healing. In vitro studies included biocompatibility and osteogenic differentiation assays (RUNX-2, ALP, COL1, BMP-2, OCN, OPN). In vivo performance was evaluated using a rat calvarial defect model.

Results:
The CCD@HapSi hydrogel exhibited fast gelation (8 ± 1 sec), a high storage modulus (~5211 Pa), strong crosslinking efficiency (85 ± 5%), and a controlled degradation rate (23.6 ± 1.6%). It significantly enhanced osteogenic marker expression—COL-1 (~14-fold), RUNX-2 (~9-fold), OCN (~4-fold), and OPN (~10-fold). In vivo, it achieved ~70% healing of 6 mm calvarial defects in 2 months, clearly outperforming controls.

Conclusion:
This multifunctional hydrogel demonstrates strong potential as a minimally invasive therapeutic for critical bone injuries, combining favorable mechanical properties with robust osteoinductive and osteoconductive capabilities. It represents a promising platform for next-generation bone tissue engineering.
Keywords: Injectable Hydrogel, Critical-sized Bone Defects (CSDs), Bone Tissue Engineering, Hydroxyapatite (HAP), Silica Nanoparticles (SiNPs), Osteogenesis.

Biography

I, Malika Arora, a Senior Research Fellow and PhD scholar at the Institute of Nano Science and Technology (INST), Mohali. I hold a bachelor's degree in Life Sciences and a master's degree in Chemistry, which laid the foundation for my interest in the interdisciplinary field of biomaterials and regenerative medicine. My current research focuses on developing injectable hydrogels for critical-sized bone defect healing, combining chemical design with biological functionality to address clinical challenges. I have six research publications and one book chapter to my name, and two additional manuscripts are currently under preparation. I have presented my work at several national and international conferences and remain actively engaged in collaborative and translational research. My goal is to contribute meaningfully to the field of tissue engineering through innovation in material science and a commitment to solving real-world biomedical problems.

Nitisha Gahlot
Indian Institute of Technology Bombay, India

Amyloid hydrogel as a scaffold for the development of patient centric-breast cancer organoids for high-throughput screening of anticancer therapeutics

Abstract

Breast cancer (BC) stands as one of the most frequently identified cancers and is the leading cause of cancer-associated deaths among women globally. While identifying unique molecular features of tumors is crucial for guiding treatment decisions, it alone may fall short in predicting clinical outcomes without functional validation. Conversely, the functional testing of BC treatments in vitro has the potential to forecast patient outcomes even in the absence of detailed molecular knowledge. It is important to note that standard two-dimensional (2D) cell culture platforms are incapable of exactly recapitulating the in vivo 3D microenvironment. However, the current 3D models also face limitations in achieving uniform and reproducible-sized spheroids, which presents a concern for drug testing and has limitations in standardization, control, monitoring, and scale-up. This study introduces a category of biomaterials formed by using non-toxic, amyloid sequences, forming thixotropic hydrogels. These amyloid fibril-based hydrogels are easy and cheap to synthesize, exhibit high stability and resistance to extreme environments (pH, temperature, and proteases), and demonstrate cell adhesion, promote stem cell differentiation into neurons, and mimic the ECM. Employing a straightforward drop-cast method in cell culture grade-well plates, these hydrogels facilitate the creation of uniform and consistently sized BC patient-derived organoids (PDOs) while maintaining the tumor heterogeneity. We have been able to establish PDOs with multiple patient biopsies of varying sizes by making single-cell suspensions and encapsulating these diverse cell types extracted from each

tumor in the amyloid hydrogel matrix. Scale-up of this technology has been achieved by passaging of mature drop-cast PDOs by manual as well as bioprinting methods. Manual and bioprinted PDOs, using CELLINK BIOX6 bioprinter, form a solid mass-like structure within a span of 1-2 weeks, mimicking the parental tumor-like feature. After appropriate phenotypic and genotypic characterization with respect to the native tumors, these developed PDOs will be used for screening the appropriate drugs at a large scale. Thus, our technology aims to provide a patient-centric personalised approach to BC chemotherapy, with a bench-to-bedside model which aids decision-making, and has massive potential to improve patient outcomes.

Biography

Nitisha finished her B.Tech. in Biotechnology from GGSIPU University, New Delhi, and was awarded the CSIR-NET Junior Research Fellowship by the Government of India at age 22 in December 2018. In 2019, she joined as a PhD scholar at the Protein Engineering and Neurobiology Lab, Biosciences and Bioengineering Department, IIT Bombay, India, under the supervision of Prof. Samir K. Maji. Her areas of expertise include cell biology, biomaterials, organoids, and bioprinting.

Renu Devi
Indian Institute of Technology Ropar, India

Sodium Alginate Hydrogels Embedded with Copper Co-Crystals and Zinc Oxide Nanoparticles for Advanced Wound Healing Applications

Abstract

The study addresses the limitations of conventional wound healing treatments by developing a multifunctional sodium alginate hydrogel incorporating copper-based co-crystals and zinc oxide nanoparticles. Chronic and acute wounds often face challenges of poor drug solubility, low bioavailability, and unstable wound conditions, which hinder effective healing. In this work, copper co-crystals were synthesized and embedded into a sodium alginate matrix, entrapping ZnO nanoparticles to improve physicochemical stability and therapeutic performance. The hydrogel exhibited a nanofibrous morphology, enhanced structural stability, and notable self-healing and viscoelastic properties. Biocompatibility assessment using A549 fibroblast cells revealed excellent cell viability and proliferation. Moreover, the system markedly upregulated angiogenic growth factors such as VEGF, FGF2, and EGFR, indicative of improved regeneration potential. Scratch assay results demonstrated faster fibroblast migration and wound closure compared to control samples. The synergistic effects of copper co-crystals and ZnO nanoparticles significantly enhanced solubility, bioavailability, and angiogenesis within the hydrogel matrix. Overall, this co-crystalloaded alginate hydrogel offers a promising and effective platform for accelerating tissue repair and promoting vascularized wound healing, representing a substantial advancement over conventional wound care approaches.

Biography

Renu Devi is pursuing her PhD (Final Year) at the Chemistry Department of the Indian Institute of Technology Ropar, Punjab (IIT ROPAR). She has published two Research Papers in ACS and one patent in developing pseudopeptide derivatives for antibacterial and wound healing applications.

Shanaia Tabitha da Cruz Fernandes
Birla Institute of Technology and Science, India

Effect of crosslinkers on Soldium Alginate-based hydrogels intended for skin tissue constructs

Abstract

Hydrogels, akin to natural tissues, are three-dimensional arrangements of hydrophilic polymers that take in and hold considerable quantities of water or biological fluids. Individual polymer chains are crosslinked to create these networks, which results in a structure that is highly hydrated but not soluble in water. Their flexibility, high water content, and biocompatibility render them useful in a variety of biomedical applications, including drug delivery and wound healing. The hydrogel's stability, mechanical strength, and biocompatibility are influenced by the selection of crosslinker, with natural polymers such as alginate. In this study hydrogels were prepared using 20% starch, 20% maltodextrin and 60% sodium alginate with four different kind of crosslinkers i.e. CaCl2, CuCl2, FeCl3 and MnCl2. The structural characterization of the cross linked hydrogels was done using Ft-IR and XRD. The water retentivity was studied via swelling studies and found to be good. The water loss was also observed in Differential Scanning Microscopy which shows an intense endothermic peak in the region 70 – 90oC. Thermogravimetric analysis shows two step degradation in the regions 40 – 80 oC and 230 -310oC. respectively in the region and in the region The biocompatibility of the hydrogels were studied using the MTT assay and hemocompatibility. Rheological Studies of wet samples show shear thickening at lower shear rate and shear thinning at higher shear rate. The mechanical strength of the lypholized samples were determined using the Instron Tensile Tester. The hydrogels were also tested for their ability to be 3D-bioprinted as bioink. The studies will aid in enhancing the development of hydrogels as bioinks for skin tissue constructs.

Biography

Shanaia Tabitha da Cruz Fernandes has completed her post-graduation degree in Chemistry and Biochemistry both through Goa University, Talegao – Goa and is now persuing her PhD in Chemistry at Birla Institute of Technology and Science, Pilani, K K Birla Goa Campus.

Tanisha Gupta
National Institute of Pharmaceutical Education and Research (NIPER), India

Enhanced Anticancer Activity of Bimetallic Nanoparticles through Photothermal Synergy

Abstract

Oral cell carcinoma has a low survival rate and a poor prognosis. Chemotherapy is the most widely used treatment for these kinds of carcinoma; however, it is more detrimental than helpful due to its cytotoxicity and insufficient specificity. To address this issue, quality-by-design (QbD) assisted laser-responsive bimetallic nanoparticles (BMNPs) were prepared. Dynamic light scattering, scanning electron microscopy, UV/Vis spectroscopy, ATR spectroscopy, EDX, and ICP-MS were used to evaluate the BMNPs developed via the one-pot aqueous synthesis approach. The oral cancer cell line was used to test its ability to kill cancer cells. Several experiments were used to examine the biological mechanism of anticancer activity. It was found that the produced BMNPs were polyhedral monodisperse particles with a negative zeta potential and a particle size in the nanometric range. Additionally, they have a strong reversible photothermal action, hemocompatibility, and an outstanding photothermal index. Photothermal therapy reduced cell viability, as determined by the cytotoxicity assay. On the other hand, after photothermal treatment, the apoptosis assay showed a higher apoptotic population. Intracellular ROS generation assay showed enhanced ROS formation with laser treatment. It was discovered that laser therapy increased the mRNA expression levels of PTEN, HSPA1A, and Caspase 3. The combination of BMNPs' cytotoxic and heating properties explains their potential as a drug-free adjuvant therapy for cancer. According to the findings, this biomaterial offers a new and promising approach for mediating laser-responsive ablation therapy in cancer cells.

Keywords: Bimetallic nanoparticles, oral cancer, photothermal therapy, apoptosis, ROS generation, mRNA modulation, Cytotoxicity.

Biography

Tanisha Gupta is a PhD scholar under Prof. Rakesh Kumar Tekade in the Department of Pharmaceutics at NIPER-Ahmedabad. She is focusing her research on targeted nanoparticulate gene delivery for cancer treatment by enabling the release of therapeutic genes via endosomal escape. Her work encompasses investigations into metallic nanoparticles for photothermal therapy, alongside exploring diverse targets for cancer as well as obesity treatment. Additionally, she is involved in the development of drug-based nano delivery systems for various diseases. She has contributed approximately 40 publications including research papers, review articles and book chapters. She was awarded with best poster presentation award in NBRCOM 2024, AIIMS-Delhi, India, and also got 1st prize in oral presntation at International Conferecne on Mesoscience 2025, Kangra, (H.P.) India.

Nidhi Pandey
Indian Institute of Technology Bombay, India

Nanomaterial doped Polyethersulfone Hollow Fiber Membranes for Bioartificial Kidney and Hemodialysis Applications

Abstract

Chronic kidney disease (CKD) remains a major global health concern affecting one tenth of world population, with current treatment options limited to hemodialysis and organ transplantation. While hemodialysis provides partial detoxification by removing small water-soluble toxins, it is ineffective in eliminating middle molecular weight and protein-bound toxins. Organ transplantation, though a definitive solution, is constrained by high costs and limited donor availability. Thus, the development of a bioartificial kidney (BAK) represents the most viable long-term solution for CKD patients.

Hemodialysis and bioartificial kidney (BAK), which mimic both physical and biological functions, can significantly impact chronic kidney disease (CKD) patients. Here we report on Hollow fiber membranes (HFMs) with enhanced separation of uremic toxins along with enhanced hemocompatibility and biocompatibility that also promote the growth of kidney cells. Fabricated HFMs were concentric, cross-section having finger-like structure, inner surface being porous. Modified HFMs showed enhanced separation performance (KUF: 152.86 ±5.01ml/m2.h.mmHg) and toxins removal of low molecular weight (urea, creatinine), middle molecular weight (lysozyme) and protein bound toxins (indoxyl sulfate). Hydrophilicity of the modified HFMs were more as compared to plain PES. Modified HFMs also showed better biocompatibility to allow the growth and proliferation of HEK-293 cells on the HFMs. The confocal images of the HFMs seeded with kidney cells showed HEK-293 cells were gathered together to form spheroid. FACS analysis also confirms that the low percentage of dead cells in the modified HFMs. The membranes also showed better hemocompatibility (< 5% hemocompatibilty limit) and low value of complement activation.

Biography

I am Nidhi Pandey, currently pursuing Ph.D. in Chemical Engineering at the Indian Institute of Technology Bombay, India, under guidance of Prof Jayesh Bellare. I am receipient of the Prime Minister's Research Fellowship (PMRF) award during my PhD tenure to carry out my research work in recognition of academic excellence and research potential. My research work focuses on the development of Hollow Fiber Membranes for Bioartificial Organs. I have numerous papers published in reputed peer-reviewed journals listed below and patents in the pipeline for submission.

Pratibha
BRIC-Translational Health Science and Technology Institute, India

Amniotic membrane ecm hydrogels: a regenerative biomaterial for diabetic wound healing

Abstract

Decellularized extracellular matrix (ECM) hydrogels are increasingly recognized as promising biomaterials for regenerative medicine owing to their ability to recapitulate the native tissue microenvironment. The human amniotic membrane (AM), a readily available and ethically acceptable tissue, is particularly rich in ECM components with inherent wound-healing potential. In this study, we developed and characterized thermosensitive hydrogels (AM ECM) derived from decellularized AM and evaluated their suitability for diabetic wound healing. AM was decellularized using a detergent enzymatic protocol, which effectively removed nuclear content while preserving key ECM proteins, collagens and glycosaminoglycans. The acellular ECM was lyophilized, cryo-milled, and digested with pepsin under acidic conditions at three concentrations, followed by neutralization and thermal gelation at 37 °C, resulting hydrogels. Physicochemical analyses revealed moderate gelation kinetics, high swelling capacity, interconnected porous architecture, and concentration-dependent mechanical stiffness and degradation rates. In vitro, AM ECM hydrogels exhibited excellent biocompatibility with fibroblasts, keratinocytes, and endothelial cells, as confirmed by live/dead staining and MTS assays. Additionally, it do not induce intracellular ROS production or apoptosis, while supporting cytoskeletal organization and cell migration. Proteomic profiling confirmed the retention of native matrisome and bioactive proteins linked to epithelial differentiation, skin development, regulation of angiogenesis, and cell migration. In vivo, AM ECM hydrogel accelerated favorable wound healing responses in a diabetic murine skin wound model. These findings highlight the influence of ECM concentration on hydrogel functionality and therapeutic

efficacy. AM ECM hydrogels represent a clinically translatable biomaterial for diabetic wound healing. Future studies will focus on optimizing gelation parameters, sterilization methods, and degradation profiles to advance clinical application.

Biography

Pratibha is a Ph.D. scholar at Translational Health Science and Technology Institute (THSTI), specializing in biomaterials and regenerative medicine. Her doctoral research is centered on the development and characterization of extracellular matrix (ECM)-derived hydrogels for soft tissue repair and diabetic wound healing applications. She has expertise in biomaterial fabrication and characterization, including digestion and gelation kinetics, swelling, porosity, biodegradation and rheology. Her work further involves comprehensive biological evaluations, such as cytocompatibility and hemocompatibility assays, oxidative stress and apoptosis analysis, cell migration and cytoskeletal organization, as well as in vivo studies using diabetic wound healing models. She is experienced in applying advanced techniques including immunostaining assay for tissue characterization. With a interdisciplinary background bridging biomaterials, cell biology, and translational applications, she aspires to contribute to innovative strategies for wound healing and tissue regeneration in postdoctoral research.


Thank You