BIOGRAPHICAL SKETCH

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NAME: RICHARD ROX ANDERSON

eRA COMMONS USER NAME (credential, e.g., agency login): ROXANDERSON

POSITION TITLE: Professor of Dermatology, Harvard Medical School
Director, Wellman Center for Photomedicine, Massachusetts General Hospital

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

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Massachusetts Institute of Technology	BS	06/1972	Biology, Education
Harvard Medical School / MIT	MD	06/1984	Medicine
Mt. Auburn Hospital (HMS affiliate)		07/1985	Medical Intern
Harvard Medical School Dermatology		07/1988	Research Fellow
Harvard Medical School Dermatology		07/1991	Resident

A. Personal Statement

The abiding theme of my research is to understand physical processes that are somehow intrinsically *selective* for affecting tissue targets. My patients are mostly children with life-altering skin problems. With a front-row seat to witness humanity's many health problems, I am deeply motivated to help solve them through research, innovation, pre-clinical and clinical studies that "translate" all the way into useful new capabilities. The work often starts with gaining a deeper understanding of a problem, then brainstorming several potential strategies, followed by assessing feasibility. This problem-driven approach often starts with fairly basic laboratory studies of molecular and cellular response mechanisms, bioengineering, prototype device design, then doing human studies, and later working with FDA and industry. I am Director of the world's largest research center in the field of biomedical optics, but my own lab within the Wellman Center is modest. I am fascinated with every stage of the long, collaborative and often unpredictable process of research, development and translation that leads to tangible impact, I teach about this at MIT, Harvard and in an online course around the world. I do some medical teaching/mentoring with fellows, residents and medical students. I am a founder of free, hospital-based clinics for children in Vietnam, Cambodia, Armenia (and soon Brazil) filled with technologies invented here. I travel with colleagues to teach local physicians in these places, which operate independently, serving thousands of children. It is fascinating how things discovered in one field can be applied in others, due to the relative isolation of specialized scientists and physicians. For example, in my lab we figured out how lipid-rich cells are preferentially sensitive to cold and launched what is now a popular treatment to remove unwanted subcutaneous fat. The underlying mechanism also affects visceral fat, and the lipid-rich myelin sheath that supports nerve conduction. We next invented injectable ice slurries and set up collaborations with otolaryngologists to treat sleep apnea and with anesthesiologists to provide non-opioid pain control, both of which are now entering clinical trials. A photobiology colleague noted that I've gone from studying the effects of light and heat on skin, to studying the effects of cold in the deep dark body. So be it.

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

1R41AR080620-01A1 (Sidoti) 09/29/2023-09/29/2024
NIH STTR Phase 1 grant
Injectable Ice Slurry Cooling Technology for Treatment of Postoperative Pain

This project aims to test the feasibility of developing a prototype device that can produce on-demand, injectable, biocompatible and sterile ice-slurry at the point-of-care for treatment of post-operative pain.
Role on Project: Subcontract academic investigator

FA9550-20-1-0063 (Anderson/Evans) 04/01/2020-03/31/2023
Department of Defense / Air Force
Military Medical Photonics Program
The major goals of this project are to further research in areas of military medicine. Dr. Anderson's project is entitled "Automated Pneumothorax Detection and Treatment." The goal of the project is to develop, test and implement in large animal studies cardiovascular device that can diagnose and treat pneumothorax. Dr. Anderson is also involved in a multi-investigator project entitled "A Spacesuit for Wounds."

HU0001-19-2-0056 (Anderson) 10/01/2019-9/30/2023
The Geneva Foundation
Photobiomodulation for performance enhancement, injury prevention, and improved recovery in the military training setting
The main goal of this project is to investigate the effectiveness of PBMT in performance enhancement and injury mitigation, under standard military training settings.

HU0001-17-2-0009 (Anderson) 06/01/2018-03/01/2022
The Henry M. Jackson Foundation for the Advancement of Military Medicine, Inc.
Transforming Technology for Warfighters
This is a multi-disciplinary/collaborative project to address novel technologies in the areas of military medicine. Dr. Anderson is involved in the 'Training and Coordination' component of this project.

FA9550-17-1-0277 (Anderson) 06/01/2018-05/31/2022
Department of Defense/Air Force
Military Medicine Photonics Program
This is a multi-disciplinary project aimed at furthering research in areas of military medicine. Dr. Anderson's project is entitled "Photobiomodulation (PBM) for improving human performance"

W81XWH-18-1-0608 (Friedstat) 09/01/18-09/29/22
Department of Defense, US Army
The Henry M. Jackson Foundation for the Advancement of Military Medicine, Inc.
A Within Scar, Randomized Control Trial Evaluating Fractional Ablative Carbon Dioxide Laser to Non-Energy Based Tissue Extraction, and No Treatment
This is a clinical study to investigate and compare two modalities for burn scar revision – ablative fractional laser and micro needle coring.
Role on Project: Investigator

W81XWH-13-2-0052 (Atala) 09/23/13-09/22/21
Department of Defense (AFIRM) (no cost extension)
Armed Forces Institute of Regenerative Medicine - Warrior Restoration Consortium
This is a multi-disciplinary project through Wake Forest University Health Sciences.
Dr. Anderson's project is entitled "Skin Copying for Wound Repair"
Role on Project: Subcontract Principal Investigator

B. Positions, Scientific Appointments, and Honors

2018- (inaugural recipient) Lancer Endowed Chair in Dermatology (Harvard), Cambridge, MA
2004- Director, Wellman Center for Photomedicine, Massachusetts General Hospital, Boston, MA
2004- Adjunct Professor, M.I.T. in the Health Sciences and Technology Program, Cambridge, MA
2004- Professor of Dermatology, Harvard Medical School, Boston, MA
1991-2004 Associate Professor of Dermatology, Harvard Medical School, Boston, MA
1987-1991 Assistant Professor of Dermatology, Harvard Medical School Boston, MA
1986-1987 Instructor of Dermatology, Harvard Medical School, Boston, MA

Member of multiple journal editorial boards
Member / lifetime member of multiple medical and scientific societies

Recent awards
2022 Inductee, U.S. National Inventors Hall of Fame
2020 Gold Medal, the highest award of the American Academy of Dermatology
2018 Presidential Citation, American Society for Lasers in Surgery and Medicine
2017 Fellow of the National Academy of Inventors
2017 William Silen Lifetime Achievement in Mentoring Award, Harvard Medical School

C. Contributions to Science

Tissue optics and optical diagnostics

Long ago I published the first mathematical model of optical radiation transfer in tissue, followed by a handful of other papers on optical dosimetry, skin optics and non-invasive optical diagnostics. This is now a rapidly growing area of biomedical engineering. I am co-inventor of the first medical confocal microscope, which is still the highest-resolution medical imaging device cleared for human use, a unique research tool, and a clinical diagnostic instrument for skin cancer.

Biological target-selective laser surgery

I envisioned and then developed target-selective thermal and mechanical effects of intense light pulses, e.g. on microvessels, pigment cells, keratinocytes, hair follicles and extracellular matrix. Today there are ~10 million patient treatments per month using "selective photothermolysis", a process that I first described in a 1983 Science article. This work spans about 50 of my published research articles over almost four decades. It created: (1) the best and current standard treatment for treating portwine stains and other microvascular malformations, (2) the only treatment for some pigmented lesions such as nevus of Ota, (3) the only non-scarring means of tattoo removal, (4) permanent laser hair removal, (5) preferential laser reduction of fat, (6) fractional laser treatments for skin, now widely used for treating burn scars. I also contributed to basic theory and understanding of tissue interactions with very high power, short laser pulses, followed by experimental verifications. I contributed to understanding mechanisms of laser lithotripsy, selective laser trabeculoplasty for glaucoma, and selective laser treatments of laryngeal cancer.

Photochemistry and photosensitization

In collaboration with biological chemists, I contributed to understanding important human photochemistry. This includes vitamin D_3 synthesis in skin via a complex photoisomerization action spectrum; for UV phototherapy mechanisms of psoralen-DNA photoadduct formation; and photodynamic therapy (PDT) that can selectively target different skin structures. For example, the first proof that PDT using aminolevulinic-acid, a natural prescursor of heme synthesis, potently suppresses acne by direct phototoxicity of sebaceous glands, came from my laboratory and subsequent clinical trial.

Cryobiology of lipid-rich tissues

My lab figured out that lipid phase changes at temperatures well above freezing, account for lipid-rich cells being exquisitely sensitive to cold. We then invented devices that led to a now-popular treatment (~10 million treatments/year worldwide) for removing unwanted subcutaneous fat. Based on the same underlying principle, we reasoned that injectable ice slurry could perform cryolipolysis deep within the body, then made the first injectable physiological ice-slurry preparations, and demonstrated the feasibility for treatment of adipose-related sleep apnea in a preclinical animal model, and as a means for prolonged nerve block and non-opioid pain control. This work was done in my lab by recruiting valuable collaborators from otolaryngology and anesthesiology, who are now taking this into clinical trials in their medical fields.

Publications:
I have co-authored over 250 reports of original research in scientific journals, and over 100 reports of clinical observations in journal articles, books, and book chapters.
I am an inventor on more than 80 issued US patents.

My Bibliography link: https://www.ncbi.nlm.nih.gov/myncbi/rox.anderson.1/bibliography/public/