Welcome

Thank you for joining the Schepens Eye Research Institute’s Fifth Biennial Military Vision Research Symposium. Over the course of these three days, we have dynamic presentations planned from researchers and administrators in both the military and civilian sectors, a poster session each day, and keynote lectures. We have also incorporated time for networking. Please refer to the following agenda, which details the plan of the next three days.

This year’s program is made possible by the Schepens Eye Research Institute; Massachusetts Eye and Ear; Harvard Medical School; United States Army Medical Research & Materiel Command; Telemedicine & Advanced Technology Research Center; and DOD-VA Vision Center of Excellence. Further, we thank our corporate sponsors Ora and CooperVision.

Mission

The Symposium will focus on Ocular & Vision Injury, and will encompass a variety of topics, including an Overview of Military & Civilian Ocular Research; Combat Ocular Readiness; Vision Funding Update; Modeling & Simulation; Ocular Pain; Inflammation & Infection; Telehealth, Telepresence & Informatics: Advanced Technologies; Blast Injury, Blast Eye; Regenerative Medicine; and Restoring the Functional Eye. The Symposium will serve as a forum, during which representatives of the military will identify their most pressing needs and scientists will present their most relevant research. Progress on previously articulated issues will also be addressed.

*Military Attire: Duty Uniform
Planning Committee

Darlene A. Dartt, Ph.D., Committee Chair
Senior Scientist, Harold F. Johnson Researcher Scholar
Schepens Eye Research Institute, Massachusetts Eye and Ear
Associate Professor, Harvard Medical School, Boston, MA

COL Donald A. Gagliano, M.D., M.HA.
DOD Principal Advisor for Vision
Executive Director, Vision Center of Excellence, Falls Church, VA

COL (Ret) Robert A. Mazzoli, M.D. F.A.C.S.
Former Consultant to the Surgeon General
Chief and Chairman, Ophthalmology
Director, Ophthalmic Plastic, Reconstructive, and Orbital Surgery
Madigan Army Medical Center, Tacoma, WA

COL (Ret) Francis L. McVeigh, O.D., F.A.A.O., M.S.
Senior Clinical Consultant, IPA
The Geneva Foundation
Telemedicine and Advanced Technology Research Center
US Army Medical Research and Materiel Command

LTC Michael Mines, M.D., D.V.M.
MC, US Army, Ophthalmology Service
Walter Reed Army Medical
Washington, DC

Marc L. Mitchell, M.B.A.
Program Analyst Telemedicine & Advanced Technology Research Center (TATRC)
U.S. Army Medical Research and Materiel Command (USAMRMC)

LTC (R) Robert C. Read, M.B.A.
Contracting Officer’s Representative
Telemedicine and Advanced Technology Research Center
U.S Army Medical Research and Material Command Fort Detrick, MD

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Project Manager
Schepens Eye Research Institute, Massachusetts Eye and Ear, Boston, MA

Ann Marie Ware
Event Manager
Schepens Eye Research Institute, Massachusetts Eye and Ear, Boston, MA

Peter Mallen
Graphics & Web Manager
Schepens Eye Research Institute, Massachusetts Eye and Ear, Boston, MA
Advisory Board

Military Physicians & Scientists:

**Lieutenant Colonel Michelle T Aaron, USAF, BSC**
Consultant to USAF Surgeon General for Optometry  
Associate Chief BSC Corps, Optometry  
Chief, Optical Radiation Bioeffects Branch, Fort Sam Houston, TX

**Jeremy Beer, Ph.D.**
United States Army Institute of Surgical Research

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CDR, MSC (AsO), USN  
Chief, Joint Medical Test & Evaluation, Defense Medical Materiel Program Office (DMMPO)  
Office of the Assistant Secretary of Defense (Health Affairs), Force Health Protection & Readiness (FHP&R), Fort Detrick, MD

**Jose E. Capo-Aponte, O.D., Ph.D., F.A.A.O.**
LTC, MS, USA  
Research Optometrist, Chief, Visual Sciences Branch, US Army Aeromedical Research Lab, Fort Rucker, AL

**Elizabeth Hofmeister, M.D.**
Captain, MC, USN  
Refractive Surgery Advisor for Navy Ophthalmology,  
Head, Navy Refractive Surgery Center San Diego,  
US Naval Medical Center, San Diego, CA

**David B. McLaren, M.D.**
Captain MC USN  
Specialty Leader, Navy Ophthalmology, Naval Medical Center Portsmouth

**Ray F. Santullo, BSC**
Col, USAF, AF Liaison to Joint Technology Coordinating Groups/Research Area Directors, Fort Detrick, MD

**Stephen G. Waller, M.D., F.A.C.S.**
Associate Professor, Dept of Preventive Med and Biometrics, Uniformed Services University of the Health Sciences, Bethesda, MD

Civilian Scientists & Administrators:

**John Brabyn, Ph.D.**
Principal Investigator, Smith-Kettlewell Eye Research Institute

**Kraig S. Bower, M.D., F.A.C.S.**
Associate Professor of Ophthalmology, Wilmer Eye Institute, The Johns Hopkins Medical School, Baltimore, MD

**Patricia D’Amore, Ph.D., M.B.A.**
Co-Director of Research, Senior Scientist & Ankeny Scholar of Retinal Molecular Biology, Schepens Eye Research Institute, Massachusetts Eye and Ear; Professor of Ophthalmology and Pathology, Harvard Medical School, Boston, MA

**Reza Dana, M.D., M.P.H., M.Sc.**
Director, Cornea & Refractive Surgery, Vice Chairman, Harvard Department of Ophthalmology, Associate Chief of Ophthalmology for Academic Programs, Massachusetts Eye and Ear; Co-Director of Research, Senior Scientist & W Clement Stone Scholar, Schepens Eye Research Institute; Claes Dohlman Chair in Ophthalmology Professor of Ophthalmology, Harvard Medical School, Boston, MA
Suzanne M.J. Fleiszig, O.D., Ph.D., F.A.A.O.
Professor of Vision Science and Optometry, Infectious Diseases & Immunity, and Microbiology, University of California, Berkeley, CA

William Good, M.D.
Principal Investigator, Smith-Kettlewell Eye Research Institute

Sarah F. Hamm-Alvarez, Ph. D.
Gavin S. Herbert Professor and Interim Chair, Department of Pharmacology and Pharmaceutical Sciences, Vice Dean for Research and Graduate Affairs, USC School of Pharmacy; Director, Office of Research Development, Southern California Clinical Translational Sciences Institute

James F. Jorkasky
Executive Director, National Alliance for Eye and Vision Research (NAEVR), Alliance for Eye and Vision Research (AEVR)

Henry J. Kaplan, M.D., F.A.C.S.
Evans Professor of Ophthalmology, Chairman, Department of Ophthalmology & Visual Sciences, Director, Kentucky Lions Eye Center, University of Louisville

Randy Kardon M.D., Ph.D.
Professor and Director of Neuro-ophthalmology, Director of Iowa City VA Center for Prevention and Treatment of Visual Loss, Pomerantz Family Chair of Ophthalmology, Department of Ophthalmology and Visual Sciences, Department of Veterans Affairs Hospital, University of Iowa Hospital and Clinics, Iowa City, IA

Todd Margolis, M.D., Ph.D.
Foundation Director, Director, Ralph and Sophie Heintz Research Laboratory, University of California, San Francisco, CA

Joan Miller, M.D.
Chief and Chair of Ophthalmology, Henry Willard Williams Professor of Ophthalmology, Massachusetts Eye and Ear, Harvard Medical School

Eli Peli, O.D.
Co-Director of Research, Senior Scientist, & Moakley Scholar in Aging Eye Research, Schepens Eye Research Institute; Professor of Ophthalmology, Harvard Medical School; Adjunct Professor of Optometry, New England College of Optometry; Adjunct Professor of Ophthalmology, Tufts University School of Medicine; Director Vision Rehabilitation Service, New England Eye Center

Joseph Rizzo, M.D.
Professor of Ophthalmology, Harvard Medical School; Director of the Neuro-Ophthalmology Service, Massachusetts Eye and Ear; Founder and Co-Director, Boston Retinal Implant Project

Gregory Schultz, Ph.D.
UF Research Foundation Professor, Department of Obstetrics and Gynecology, Institute for Wound Research, University of Florida, Gainesville, FL

Earl Smith, O.D., Ph.D.
Dean, Greeman-Petty Professor, University of Houston College of Optometry

Michael Young, Ph.D.
Associate Scientist & de Gunzburg Director, Minda de Gunzburg Research Center for Ocular Regeneration, Schepens Eye Research Institute; Associate Professor of Ophthalmology, Harvard Medical School
Military Vision Symposium
Tuesday, September 18, 2012

8:00a.m. – 8:30a.m.  Breakfast

**Opening Session: Overview of Military & Civilian Ocular Research**
Session Moderators: Darlene Dartt, Ph. D. & COL Donald Gagliano, M.D. M.H.A.

8:30a.m. ~ 8:40a.m.  *Introduction*
John Fernandez, President & CEO, Massachusetts Eye and Ear

8:40a.m. ~ 8:55a.m.  *Congressional Perspective*
Congressman Michael Capuano

8:55a.m. ~ 9:15a.m.  *Welcome*
Joan Miller, M.D.

9:15a.m. ~ 9:35a.m.  *Future of US Army Medicine*
COL Donald Gagliano, M.D., M.H.A.

9:35a.m. ~ 9:55a.m.  *Political History of Center of Excellence and Research*
Thomas Zampieri, Ph.D.

9:55a.m. – 10:10a.m.  Morning Break

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**Combat Ocular Readiness**
Session Moderators: Ula Jurkunas, M.D. & LTC Michael Mines

10:10a.m. – 10:40a.m.  *Keynote: Combat Ophthalmology*
Col. Randall Beatty, M.D., F.A.C.S.

10:40a.m. ~ 11:00a.m.  *Combat Eye Protection and Eye Injury Surveillance Update*
Col. David Hilber, O.D., M.B.A., F.A.A.O.

11:00a.m. ~ 11:20a.m.  *Collagen Cross-Linking for Keratoconus*
Kathryn Colby, M.D., Ph.D.

11:20a.m. ~ 12:00p.m.  Panel Discussion
Dr. Beatty, Dr. Hilber, & Dr. Colby

12:00p.m. ~ 2:00p.m.  Lunch & Poster Session
**Vision Funding Update**
Session Moderator: Michael Young, Ph.D.

2:00 p.m. ~ 2:30 p.m.  *Department of Defense Vision Research Program*
James Jorkasky & LTC (R) Robert Read, M.B.A.

**Modeling & Simulation**
Session Moderators: COL (R) Robert Mazzoli, M.D. & Joseph Rizzo, M.D.

2:30 p.m. ~ 3:00 p.m.  *Keynote: Impact of Advanced Technology on the Future of Surgery*
Richard Satava, M.D., F.A.C.S.

3:00 p.m. ~ 3:20 p.m.  *Cognitive Simulations for Medical Teaching*
John Loewenstein, M.D.

3:20 p.m. ~ 3:40 p.m.  *Eye Trauma Simulation - Review and Novel System Development*
Mark P. Ottensmeyer, Ph.D.

3:40 p.m. ~ 4:30 p.m.  *Panel Discussion*
Dr. Satava, Dr. Loewenstein, & Dr. Ottensmeyer

6:00 p.m. ~ 9:00 p.m.  *Gala Reception*
Starr Center, Schepens Eye Research Institute

*Each talk includes a 5 minute Q&A session*
Wednesday, September 19, 2012

8:00a.m. – 8:30a.m.  Breakfast

**Modeling & Simulation**

8:30a.m. ~ 8:50a.m.  *Decision-Support Technologies for Diagnosis of Trauma Patients: Major Hemorrhage and Traumatic Brain Injury*
Jaques Reifman, Ph.D.

**Ocular Pain**
Session Moderators: Reza Dana, M.D., M.P.H., M.Sc. & James Chodosh, M.D., M.P.H.

8:50a.m. ~ 9:10a.m.  *Ocular Pain: Framing the Clinical Issues*
Todd Margolis, M.D., Ph.D.

9:10a.m. ~ 9:30a.m.  *Current Concepts in PRK Pain Management*
Kraig S. Bower, M.D., F.A.C.S.

9:30a.m. ~ 9:50a.m.  *New Approaches Toward Objective Evaluation and Treatment of the Most Common Symptom of TBI – Light Sensitivity*
Randy Kardon, M.D., Ph.D.

9:50a.m. ~ 10:35a.m.  Panel Discussion
Dr. Margolis, Dr. Bower, & Dr. Kardon

10:35a.m. ~ 10:50a.m.  Morning Break

**Inflammation & Infection**
Session Moderators: Meredith Gregory-Ksander, Ph.D. & COL (R) Robert Mazzoli, M.D.

10:50a.m. ~ 11:20a.m.  *Keynote: Neutrophils as First Responders in Corneal Infection and Inflammation – a Double-Edged Sword*
Eric Pearlman, Ph.D.

11:20a.m. ~ 11:40a.m.  *Endophthalmitis Prophylaxis: What are we doing?*
CAPT Jeffrey Blice, M.D.

11:40a.m. ~ 12:00p.m.  *Contact Lens Drug Delivery*
Joseph Ciolino, M.D.

12:00p.m. ~ 12:20p.m.  *Towards "Green" Methods for Preventing Infection*
Suzanne Fleiszig, O.D., Ph.D., F.A.A.O.

12:20p.m. ~ 2:00p.m.  Lunch & Poster Session
**Telehealth, Telepresence & Informatics:**

*Advanced Technologies*

Session Moderators: COL (R) Franis McVeigh, O.D., M.S. & Louis Pasquale, M.D.

2:00 p.m. ~ 2:30 p.m.  
**Keynote:** *The U.S. Army Telemedicine Program – Making a Difference at Home and Abroad*  
Ronald Poropatich, M.S., M.D.

2:30 p.m. ~ 2:50 p.m.  
**Doctors Listen:** *The Balance of Power is Changing*  
Francis McVeigh, O.D., M.S., F.A.A.O.

2:50 p.m. ~ 3:10 p.m.  
**Expanding the Boundaries of Diabetes Eye Care**  
Lloyd Aiello, M.D. & Jerry Cavallerano, OD, PhD

3:10 p.m. ~ 3:30 p.m.  
**Keynote:** *Facilitating Meaningful and Effective Patient Interactions During Video Conferencing*  
Jay Shore, M.D., M.P.H.

3:30 p.m. ~ 3:50 p.m.  
**Deploying a Diabetic Retinopathy Photo Screening System into a Large Health System: What is the Right Model**  
Steven Waller, M.D., F.A.C.S.

3:50 p.m. ~ 4:10 p.m.  
**Use of Non-Mydriatic Retinal Screening to Improve Outcomes in Military Healthcare Beneficiaries**  
Robert Vigersky, M.D. F.A.C.P.

4:10 p.m. – 4:55 p.m.  
**Panel Discussion**  
Dr. Aiello, Dr. Cavallerano, Dr Shore, Dr Waller, & COL Vigersky

*Each talk includes a 5 minute Q&A session*
Thursday, September 20, 2012

8:00a.m. – 8:30a.m.  Breakfast

Ocular Pain & Refractive Surgery
Session Moderators: Pedram Hamrah, M.D. & COL Mark Torres, M.D.

8:30a.m. ~ 9:00a.m.  Keynote: Neural Mechanisms of Ocular Discomfort and Pain in Extreme Environmental Conditions
Carlos Belmonte, M.D., Ph.D.

9:00a.m. ~ 9:20a.m.  Military Refractive Surgery:  2012 Snapshot
CAPT Elizabeth Hofmeister, M.D.

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9:20a.m. ~ 9:35a.m.  Morning Break

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Blast Injury, Blast Eye
Session Moderators: Matthew Gardiner, M.D. & CAPT David McLaren, M.D.

9:35a.m. ~ 10:05a.m.  Keynote: Blast Physics: In the Blink of an Eye…
David Ritzel, M.A.S.c.

10:05a.m. ~ 10:25a.m. A Mouse Model of Ocular Blast Injury:
Clinical Manifestations and Genetic Susceptibility
Tonia Rex, Ph.D.

10:25a.m. ~ 10:45a.m. Ocular Trauma at Walter Reed Army Medical Center: 2001-2011
MAJ Marcus Colyer, M.D.

10:45a.m. ~ 11:05a.m. Dry Eye Disease in Veterans with Neurotrauma
Glenn Cockerham, M.D.

11:05a.m. ~ 11:25a.m. Blast Injury and the Orbit
COL Sheri De Martelaere, M.D.

11:25a.m. ~ 11:45a.m. Chronic Traumatic Encephalopathy in Blast-Exposed U.S. Military Veterans and a Blast Neurotrauma Mouse Model: Implications for Military Eye Injury and Vision Research
Lee Goldstein, M.D., Ph.D.

11:45a.m. ~ 12:15p.m. Panel Discussion
Mr. Ritzel, Dr. Rex, Dr Colyer, Dr. Cockerham, COL Martelaere, & Dr. Goldstein

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12:15p.m. ~ 2:00p.m.  Lunch & Poster Session
**Regenerative Medicine**  
Session Moderators: James Zieske, Ph.D., & Magali Saint-Geniez, Ph.D.

2:00p.m. ~ 2:30p.m.  Keynote: *Facial Restoration by Transplantation*  
Bohdan Pomahac, M.D.

2:30p.m. ~ 2:50p.m.  *Development of Stem Cell Based Therapies for the Treatment of Retinal Degenerative Disease*  
Budd Tucker, Ph.D.

2:50p.m. ~ 3:10p.m.  *Stem Cell Derived Retinal Transplantation: The First Human Experience*  
Steven D. Schwartz, M.D.

3:10p.m. ~ 3:30p.m.  *Photoreceptor Regeneration in Swine Model of Retinal Degeneration*  
Henry Kaplan, M.D., F.A.C.S.

**Restoring the Functional Eye**  
Session Moderators: Eli Peli, O.D & John Wyatt, Ph.D.

3:30p.m. ~ 3:50p.m.  *Visual Prosthetic Approaches to Visual Restoration After Traumatic Injury*  
Joseph Rizzo, M.D.

3:50p.m. ~ 4:10p.m.  *Perceptual Characteristics of V1 Microstimulation via an Array of Microelectrode at Greater than 18 Months of Implantation*  
Bradley Greger, Ph.D.

4:10p.m. ~ 4:30p.m.  *Sensory Substitution for Functional Vision Restoration*  
Anil Raj, M.D.

4:30p.m. ~ 5:00p.m.  Panel Discussion  
Dr. Rizzo, Dr. Greger, & Dr. Raj

*Each talk includes a 5 minute Q&A session*
Doctor Joan Whitten Miller was born in Toronto, Ontario, Canada and is a graduate of Massachusetts Institute of Technology and Harvard Medical School. She completed her ophthalmology residency and a vitreoretinal fellowship at Massachusetts Eye and Ear Infirmary. Dr. Miller is the first female physician promoted to the rank of Professor of Ophthalmology at Harvard Medical School, and the first woman to serve as chair of the Department of Ophthalmology. Additionally, Dr. Miller is the director of Mass. Eye and Ear’s Angiogenesis Laboratory and a vitreo-retinal physician in the Retina Service at the Infirmary.

Dr. Miller’s research interests focus on ocular neovascularization, particularly as it relates to age related macular degeneration (AMD) and diabetic retinopathy, including the molecular mechanisms of angiogenesis and neuroprotection, the development of effective therapies, and drug delivery. She and her colleagues at Mass. Eye and Ear pioneered the development of photodynamic therapy (PDT) using verteporfin (Visudyne®), the first pharmacologic therapy for AMD able to reduce and slow vision loss. The group also identified the importance of vascular endothelial growth factor (VEGF) in neovascular AMD, and helped develop the anti-VEGF therapies pegaptanib and ranibizumab—the latter able to improve vision in about one-third of patients with neovascular AMD. While these approaches have improved the outlook for patients with AMD, Dr. Miller and her colleagues continue investigations to elucidate the pathophysiology of vision loss and improve therapies for AMD.

An internationally recognized expert in the field of macular degeneration, Dr. Miller has published more than 130 peerreviewed papers, 50 book chapters and review articles, is coeditor of the third edition of Albert and Jakobiec's Principles and Practice of Ophthalmology, and is a named inventor on nine U.S. patents and five Canadian patents. She has received numerous awards, including the Rosenthal Award and Donald J. Gass Medal of the Macula Society, the Retina Research Award from the Club Jules Gonin, the Alcon Research Institute Award, the ARVO/Pfizer Ophthalmic Translational Research Award, the Founder’s Award from the American Society of Retinal Specialists, the Harvard Medical School 2010 Joseph B. Martin Dean's Leadership Award for the Advancement of Women Faculty, the Suzanne Veronneau-Troutman Award from Women in Ophthalmology, the Senior Achievement Award from the American Academy of Ophthalmology and a Pinnacle Award for Achievement in the Professions from the Greater Boston Chamber Women's Network. Dr. Miller will deliver the 2012 Edward Jackson Lecture for the American Academy of Ophthalmology.

Dr. Miller and her husband John live in Winchester, MA. John, a construction attorney, specializes in domestic and international engineering procurement and public-private partnerships in global infrastructure. Their son John, the eldest of three children, is currently an ophthalmology resident at Harvard Medical School. Their son Douglas is a 2010 graduate of Harvard College, where he was co-captain of his college basketball team; he now works in construction management for Schernecker Property Services. Daughter Mary graduated from Harvard College in 2011, and is working as a paralegal for the law firm Harkins Cunningham LLP in Philadelphia.
Mr. Zampieri is a graduate of Hahnemann University Physician Assistant Program in Philadelphia, June 4, 1978, obtained his Bachelor Science degree from State University of NY. Graduate Master Political Science from University St. Thomas in Houston, May 15, 2003. Completed his Ph. D. dissertation from Lacrosse University in Political Science December 15, 2005, and is employed, as the National Director of Government Relations for the Blinded Veterans Association BVA since April 22, 2005, a congressionally chartered veteran service organization that has been in existence for sixty-five years.

He served on active duty in the U.S. Army from September 11, 1972 to September 10, 1975 as an Army medic, after Physician Assistant program he served from August, 1978 until August, 2000 for 22 years, as Army National Guard Physician Assistant in three different states, retiring at the rank of Major. During this time, he was involved in several military medical training programs and schools, and was a graduate of the Army Flight Surgeon Aeromedical Course at Fort Rucker in 1989, and the AMEDD Advanced Officer Course at Fort Sam Houston Texas in 1992 and held a Secret Security clearance as military officer in Army National Guard.

He has worked for several years on recommendations for the Veteran Service Organizations annual Independent Budget sent to the White House, VHA, and Congress on VA appropriations, health care and benefits issues. He has experience in providing congressional testimony before House Veterans Affairs Committee and with submitting written congressional testimony, development of legislative briefing papers, policy white papers, and over 900 appointments with congressional offices in recent years working on various VA, DoD, and federal health care and disability issues. The past two sessions of 110th and 111th congress he worked extensively on issue of Seamless Transition for combat eye wounded and service members with TBI visual dysfunction. BVA was successful in enactment of the DOD/VA Vision Centers of Excellence (Public Law 110-181, Section 1623), being included in the National Defense Authorization Act (NDAA) of FY 2008. His legislative efforts on expansion of outpatient blind and low vision rehabilitation programs has resulted in the expansion of the VA Continuum of Care for blind and low vision veterans’ outpatient programs opening 55 new programs with 237 employees. Other benefits for disabled veterans have been updated as result of other pieces of legislation.

Previously he was employed in health care field, as clinical Physician Assistant for over 23 years, 19 of those within the Department of Veterans Affairs medical centers in Canandaigua, New York, Richmond, Virginia and Houston, Texas. During this time he was co-author of several different medical journal articles on urology, spinal cord injury, and interviewed for news articles. He held clinical PA instructor appointments at Alderson-Broaddus College Department of Medical Sciences in West Virginia, and at Baylor College of Medicine, PA Program, in Houston, Texas from 1994 to 2001 and was appointed as Clinical Instructor in the Scott Department of Urology Baylor Surgery.

During his 19 years in the VA he assisted with the development of new PA Clinical practice guidelines, recruitment and retention programs for career development and upward mobility, educational assistance for PA students and encouraged academic affiliations with PA programs. Worked extensively on changes to Title 38 Human Resources PA employment chapter in 1993, served as co-chairman for three national CME satellite teleconferences with joint VA and DOD health care facilities, and was a member of VA Physician Assistant Field Advisory Group from 1990 to 1993. He was appointed to the Institute of Medicine, National Academy of Science Committee on Department of Veterans Affairs Physician Staffing Requirements, and Non-Physician Practitioners Panel from 1990-1992.

He is a life member of the American Legion, Disabled American Veterans, Blinded Veterans Association, Vietnam Veterans of America, Military Officers Association America., and on April 22, 2002 became Charter member of Pi Sigma Alpha National Political Science Honor Society while obtaining his Master’s degree.
Combat Ocular Readiness

Colonel Randall Beatty, M.D., F.A.C.S.
Department of Ophthalmology
Allegheny General Hospital
332nd Expeditionary Medical Operations Squadron
United States Air Force
Pittsburgh, PA

Dr. Beatty is a hospital based orbital/ oculoplastic specialist practicing in Pittsburgh. Positions of employment have included active duty military, private practice, part-time VA, and full time university academics. He has vast experience in civilian as well as military ocular and facial trauma, and humanitarian surgical eyecare throughout the world.

He has provided surgical eye care on humanitarian missions in Central America, South America, Asia and Europe. He is also a Colonel in the USAF Reserve Medical Corp attached to Wilford Hall Medical Center, San Antonio, Texas. In this capacity he has treated US Military injuries during Just Cause, Desert Storm, Iraqi Freedom, and Enduring Freedom. He has been deployed to Balad, Iraq in 2008 and Bagram, Afghanistan in 2011-12 as Chief of Ophthalmic Surgery for the AOR. Colonel Beatty is also very involved in teaching activities such as the Annual Tri-Service Ocular Trauma Course held each year at Bethesda Naval and USU.
COL David J. Hilber is a 1989 graduate of the Pennsylvania College of Optometry and earned his MBA from Baruch College in 1999. He is currently the Portfolio Executive Officer for Occupational and Environmental Medicine and a member of the Tri-Service Vision Conservation and Readiness Program at the US Army Public Health Command at Aberdeen Proving Grounds, MD. He served as the Army’s North Atlantic Regional Medical Command Optometry Consultant from 2007-2011 and was the Federal Service representative to the American Optometric Associations Federal Relations Committee from 2005-2011. He has served as a staff optometrist (98th General Hospital, Germany), Residency Program Supervisor (West Point), Clinic Chief (USA MEDDAC, Wurzburg, Germany), and as the Deputy Commander for Ancillary Services at the Dilorenzo Tricare Health Clinic, Pentagon. He deployed to Iraq in April of 2006 and served with the 21st Combat Support Hospital as the Chief of Optometry for Detainee Healthcare. In 2003 he developed an on-line coding guide for military optometrists and since 2005 has worked on the advancement of the Army’s Vision Readiness Screening and Military Combat Eye Protection Programs. In 2011, in conjunction with the Armed Forces Health Surveillance Center, he completed the development of an ICD-9 code based, recurring eye injury surveillance report for DoD Active Duty military members. Publications include:

Kathryn Colby, MD, PhD is a cornea surgeon at Massachusetts Eye and Ear Infirmary in Boston and an Associate Professor of Ophthalmology at Harvard Medical School. Following undergraduate work at Johns Hopkins and a PhD in Neurobiology at Brown University, she graduated summa cum laude from the University of Maryland Medical School. Dr. Colby completed residency, chief residency and fellowship at Mass Eye and Ear, where she has been on staff since 1996.

Dr. Colby’s areas of expertise include Fuchs’ corneal dystrophy, novel surgical treatments for corneal diseases, and ocular surface tumors. In addition, Dr. Colby has an active pediatric cornea practice at Boston Children’s Hospital. She has a special interest in clinical research and served for many years as the founding director of the Joint Clinical Research Center, a collaborative endeavor between MEEI and the Schepens Eye Research Institute, Boston, as well as chair of the MEEI IRB. She has numerous publications and is invited to speak nationally and internationally on both corneal and clinical research topics. She has served on multiple committees for the American Academy of Ophthalmology and is currently the Chair of the Cornea Subcommittee of the Annual Meeting Planning Committee. She was recently elected to the Board of Directors of the Cornea Society.
Combat Ocular Readiness

**Keynote: Combat Ophthalmology**

Col. Randall Beatty, M.D., F.A.C.S.

Eye injuries in war have changed over time as weapons, tactics, strategy, and technology have influenced war fighting. Historical data on ocular injuries will be presented along with current case presentations of military and civilian combat casualties. The cases are taken from wounded in both the Iraq and Afghanistan theatre of war will be presented and discussed. Lessons learned from this experience will be discussed in hopes of decreasing future military ocular injuries.

**Combat Eye Protection and Eye Injury Surveillance Update**

Col. David Hilber, O.D., M.B.A., F.A.A.O.

This presentation will discuss the current status of the Military Combat Eye Protection Program (what's new, issues, future initiatives, use and effectiveness data) and provide an update on the most recent data received from the Armed Forces Health Surveillance Center's Annual Eye Injury Report.

**Collagen Cross-Linking for Keratoconus**

Kathryn Colby, MD, PhD

Keratoconus, an ectatic disorder characterized by progressive corneal thinning and induced irregular astigmatism, is a common cause of vision loss in young adults. The prevalence of keratoconus is approximately 1 in 2000. In 1998, investigators in Germany initiated the use of collagen cross-linking using topical riboflavin and UV light in patients. This treatment is currently approved in Europe. FDA-sanctioned trials are currently ongoing in the US. Collagen cross-linking with riboflavin and UV light is a promising technology that appears to be safe and effective at halting the progression of keratoconus. This is the first treatment option for this disease that addresses the underlying pathophysiology. This technology may be applied to other conditions of the cornea in which corneal melting occurs. This presentation will review the scientific basis of collagen cross-linking, outcomes of completed trials and potential complications with the technique.

James Jorkasky has served as the Executive Director of the National Alliance for Eye and Vision Research (NAEVR), a 501c4 advocacy organization, and the Alliance for Eye and Vision Research (AEVR), a 501c3 educational foundation, since 2003.

The Alliances, which serve as the “Friends of the National Eye Institute (NEI)” and represent the breadth of the community of support for eye and vision research, engage in advocacy and education, respectively, for the value and cost-effectiveness of federally funded eye and vision research conducted by the NEI, the Department of Defense (DOD), the Department of Veterans Affairs (VA), and other federal entities.

Mr. Jorkasky is a research biochemist by training who has 30 years of health care policy experience, primarily from senior positions at the Advanced Medical Technology Association (AdvaMed), where he founded the Ophthalmic Devices Sector, and the American Association for Homecare. He received his B.A. in Chemistry from The College of Wooster and M.B.A. from The George Washington University.
Robert Read is a native of Pittsburgh, Pennsylvania where he earned a Bachelor of Arts degree in Urban Management from the University of Pittsburgh. He completed a Master of Business Administration degree with a concentration in Organizational Behavior from Saint Mary’s University in San Antonio, Texas.

In April of 2001, Mr. Read completed a 31-year army career, retiring in the grade of Lieutenant Colonel. Positions of note included: Inspector General, U. S. Army Medical Research and Materiel Command; Chief of Personnel, Europe Regional Medical Command; Chief of Personnel and Troop Commander, Landstuhl Regional Medical Center; Chief of Personnel, U. S. Total Army Personnel Command; Chief of Personnel Operations, U. S. Army Health Services Command; Instructor, U. S. Army Academy of Health Sciences; Recruiter, U. S. Army Medical Personnel Support Agency; Chief, Medical Assistance Team, U. S. Army Readiness Group Pittsburgh; Assistant to the Division Surgeon and Company Commander, 4th Medical Battalion, U. S. Army 4th Infantry Division (Mechanized); Company Commander, Kenner Army Hospital; Adjutant and Patient Administration Officer, 85th Combat Support Hospital.

Since February 2001, Mr. Read has been employed as a Program Manager/Analyst with the Telemedicine and Advanced Technology Research Center (TATRC) at Fort Detrick, MD. During this timeframe he has been employed as a contract employee, IPA and is now a Department of the Army Civilian. His primary responsibilities include managing advanced medical research and development programs; nominating, supervising and mentoring contracting officer/grants officer representatives and project officers; analyzing and developing program goals and objectives to fill research gaps; developing program announcements and managing the selection process; and developing and delivering white papers and presentations. He is the program manager for diabetes, pain and vision; providing oversight on 63 active projects. He is the coordinator of the peer reviewed Vision Trauma Research Program which has funded or will fund 33 projects in the amount of $25.6M.

Mr. Read is a member of the Association for Research in Vision and Ophthalmology, the American Telemedicine Association, and the Ocular Special Interest Group of the American Telemedicine Association.
Prior positions include Professor of Surgery at Yale University and a military appointment as Professor of Surgery (USUHS) in the Army Medical Corps assigned to General Surgery at Walter Reed Army Medical Center and Program Manager of Advanced Biomedical Technology at the Defense Advanced Research Projects Agency (DARPA) and Senior Science Advisor at the US Army Medical Research and Materiel Command in Ft. Detrick, Maryland.

His undergraduate training was at Johns Hopkins University, Medical School at Hahnemann University of Philadelphia, Internship at the Cleveland Clinic, Surgical Residency at the Mayo Clinic, and a Fellowship with a Master of Surgical Research at Mayo Clinic.

He has served on the White House Office of Science and Technology Policy (OSTP) Committee on Health, Food and Safety. He is currently a member of the Emerging Technologies and Accredited Education Institutes of the American College of Surgeons (ACS), is past president of the Society of American Gastrointestinal Endoscopic Surgeons (SAGES), past president of the Society of Laparoendoscopic Surgeons (SLS), and was on the Board of Governors of the National Board of Medical Examiners (NBME). He is currently on Board of a number of surgical societies and on the editorial board of numerous surgical and scientific journals, and active in numerous surgical and engineering societies.

He has been continuously active in surgical education and surgical research, with more than 200 publications and book chapters in diverse areas of advanced surgical technology, including Surgery in the Space Environment, Video and 3-D imaging, Telepresence Surgery, Virtual Reality Surgical Simulation, and Objective Assessment of Surgical Competence and Training and Moral and Ethical Impact of Advanced Medical Technologies.

During his 23 years of military surgery he has been an active flight surgeon, an Army astronaut candidate, MASH surgeon for the Grenada Invasion, and a hospital commander during Desert Storm, all the while continuing clinical surgical practice. While striving to practice the complete discipline of surgery, he is aggressively pursuing the leading edge of advanced technologies to formulate the architecture for the next generation of Medicine.
**John Loewenstein, M.D.**  
Program Director Harvard Medical School Ophthalmology Residency  
Vice Chair of Education in Ophthalmology Harvard Medical School  
Associate Professor of Ophthalmology Harvard Medical School  
Associate Clinical Chief of Ophthalmology Massachusetts Eye and Ear  
Boston, MA

John I Loewenstein, MD, is a graduate of Massachusetts Institute of Technology Technology and SUNY Buffalo Medical School. He did his internship at the Washington Hospital Center, followed by residency and fellowship at Boston University Affiliated Hospitals.

Dr. Loewenstein is an Associate Professor, Vice Chair for Education, and Director of Residency Training in Ophthalmology at Harvard Medical School. He is a retina specialist at the Massachusetts Eye and Ear Infirmary, where he serves as Associate Chief of Ophthalmology for Clinical Affairs.

Dr. Loewenstein’s research interest is in surgical education and creation of computer based tools for surgical learning.
Dr. Mark P. Ottensmeyer, Ph.D.
Research Lead, The Simulation Group
Assistant in Research, Department of Imaging, Massachusetts General Hospital
Assistant Professor, Harvard Medical School
65 Landsdowne St., #209 / Cambridge, MA, 02139

Dr. Mark P. Ottensmeyer is the Research Lead of the Simulation Group, an R&D laboratory within the Department of Imaging at Massachusetts General Hospital, developing prototype medical training systems and supporting related research. He is currently leading an effort to develop an augmented physical simulator for eye and face trauma with motion tracking and autonomous feedback elements, and additional projects to create modular enhancements for low-cost medical training mannequins, a hand-held haptic interface for IV start training and an artificial, pulsatile IV arm replacement for a commercial medical training mannequin. He was worked on medical training simulators including the COMETS synthetic trauma patient, the Virgil chest trauma simulator, and the CELTS prototype laparoscopy training system. His research efforts have included developing instruments to measure the mechanical properties of soft tissues, with particular interest in solid organs including liver, spleen, kidney and brain, and the vibratory tissues of the vocal tract, and a device for stimulating skin growth to study wound healing.

Dr. Ottensmeyer received M.S. and Ph.D. degrees in mechanical engineering at MIT, developing a telesurgery testbed system for investigating the effects of communication time delays on performance, and a minimally invasive tissue property measurement instrument. He has written and contributed to 13 peer reviewed journal and conference papers, 15 other conference papers, is a co-inventor on three US and worldwide patent applications, and has served on doctoral committees at MIT. Awards and recognitions have included a 2004 MGH Partners in Excellence award, the 2003 US Army Greatest Invention Award and the 2003 Edward M. Kennedy Award for Healthcare Innovation, and the Virgil chest trauma trainer was exhibited in the Wellcome Gallery, Deutsches Hygiene-Museum and the Canadian War Museum between 2008 and 2011.
Jaques Reifman, Ph.D., is a Department of the Army Senior Research Scientist and, as such, a member of the Department of Defense (DoD) Senior Executive corps. He serves at the U.S. Army Medical Research and Materiel Command's (USAMRMC) Telemedicine and Advanced Technology Research Center, at Fort Detrick, Maryland, where he is also the Director of DoD's Biotechnology High Performance Computing Software Applications Institute for Force Health Protection (BHSAI), which he created. In addition, he is an Adjunct Professor of Biomedical Informatics of the Uniformed Services University of Health Sciences. The Army recruited Dr. Reifman in 2001 from the U.S. Department of Energy’s Argonne National Laboratory, Illinois, where he served as a Section Manager. Over a 12-year tenure at Argonne, he conducted and led basic and applied research in computational methods, artificial intelligence, advance control algorithms, and statistical pattern recognition.

As a Department of the Army Senior Scientist, Dr. Reifman advises, leads, and conducts research in a broad range of disciplines, including medical- and bio-informatics, artificial intelligence, data mining, mathematical modeling and simulation, high-performance computing, computer-based decision support, genomics and proteomics, systems biology and network science, and computer science technologies for medical applications. Composed primarily of physical scientists with diverse backgrounds, the BHSAI complements and collaborates with the DoD’s life scientists in pursuing interdisciplinary research to develop medical countermeasures of military relevance, including drugs, vaccines, diagnostic assays, decision-support algorithms, and knowledge products. In his role, Dr. Reifman interacts with senior military leaders, scientists, and investigators throughout the USAMRMC and the DoD, and scientists and executives from other government agencies, academia, and the private sector.

Dr. Reifman is responsible for creating the Army’s and DoD’s capabilities in computational biology. He has authored over 140 peer-reviewed technical publications and book chapters and is the inventor of six U.S. patents. He serves as a reviewer of multiple journals and as an Associate Editor and as an Editorial Board member of different journals. He is the recipient of the 1990 Mark Mills Award presented annually by the American Nuclear Society to “honor a graduate student for the best original technical paper contributing to the advancement of nuclear science and engineering,” a 1998 R&D 100 Award presented annually by R&D Magazine for the “most significant technical products of the year,” several Argonne National Laboratory Productivity Awards (1995, 1997, and 1999) “in recognition of performance significantly beyond job expectations in areas of importance to the Laboratory,” a 2008 Arthur S. Flemming Award in “recognition of outstanding achievement while working for the federal government,” and a 2009 Presidential Rank Award by President Barak Obama. In 2009, he was elected to the Order of Military Medical Merit.

Born in 1957 in Rio de Janeiro, Brazil, Dr. Reifman received his Ph.D. and Masters in Nuclear Engineering from the University of Michigan, Ann Arbor, in 1989 and 1985, respectively. He also obtained a Bachelors degree in Business Administration from the Rio de Janeiro Federal University in 1985, and a B.S. in Engineering from the Rio de Janeiro State University in 1980.
Keynote: Impact of Advanced Technology on the Future of Surgery
Richard Satava, M.D., F.A.C.S.

There has never been a time in history with such an overwhelming introduction of new technologies. There is a convergence of multiple sciences - biology, physics, mathematics, engineering, etc that has led to a fundamental revolution in Healthcare. It is critical to understand we are in the Information Age, and we must re-think from the most basic principles on how to adopt and adapt to these rapidly introduced technologies. Robotic surgery has been established as a key new information age technology that is changing the way we perform surgery, the electronic medical record needs to go to the next generation and remote surgery is a proven application. And as these technologies rapidly emerge, we must address the educational and training issues to insure the highest quality of healthcare and patient safety. Technology is offering one powerful solution - simulation. Whether manikin, synthetic models, computer-based training, or full virtual reality, the future foe education will require simulation to provide the necessary tools to learn the new sciences.

Beyond those immediate applications, there looms even more radical innovation. Tissue engineering and regeneration, brain controlled prostheses, plasma medicine, optogenetics and biophotonics, micro -robots, nanotechnology and cellular surgery are but a few of the discoveries that will change what it means to be a surgeon, physician or nurse - and whether the patient has surgery, drug or transplantation or energy based therapy - or a combination of many.

The technologies have moved so rapidly that we have not had an opportunity to have public discussion as to the moral and ethical implications of these changes. We failed miserably in addressing human cloning (stop the research!), but where are we going with even more radical technologies. It is imperative that as we push the limits of science, we must also address the humanistic, moral and ethical issues as well.

Cognitive Simulations for Medical Teaching
John Loewenstein, M.D.

The apprenticeship method of medical and surgical teaching has significant limitations which are becoming more apparent as residency curricula become more formal. In addition pressures on faculty time have encouraged new approaches to resident and medical student education. We have used an “immersion story” method to create new teaching tools. The tools emphasize error recognition and correction. Our initial effort was a computer based simulation for teaching the cognitive aspects of cataract surgery separately from the motor aspects. A key feature is the use of “just in time” feedback in the form of expert stories. A multicenter randomized trial of a prototype demonstrated the effectiveness of this method as an adjunct to conventional teaching. The cataract simulation is now available through a license to ASCRS. A short demonstration of the program will be presented. We are now developing a program for teaching screening for retinopathy of prematurity, and a prototype will be demonstrated.
Eye Trauma Simulation - Review and Novel System Development
Mark P. Ottensmeyer, Ph.D.
As with other areas of medicine, simulation technology is being applied to ophthalmology in myriad ways. Mathematical models enable surgical planning and predictive modeling of injury mechanisms. Physical, virtual and hybrid systems are being used for training from suturing technique to cataract surgery to vitreo-retinal procedures. The physical elements and haptic interfaces provide tactile feedback to support developing muscle memory, the sensors and numerical models provide quantitative measurements to enable evaluation and feedback to the trainee. A notable unaddressed domain is traumatic injury to the globe and adnexa. Training for repair of complex lacerations, especially of the lids, is limited mostly to cadaver and animal tissue, and except for trauma specialists, is likely not to have been a recent experience. Similarly, first responders, who can protect an injured eye to permit more successful surgical outcomes, have limited exposure to realistic eye trauma. This presentation will introduce trauma-related simulation programs and systems and present ongoing research and development of a hybrid system to address training needs of both the surgeon and the first responder. The simulator combines physical simulated anatomy, detects meaningful elements of instrument motions, and responds to sequences of gestures with instruction and feedback for scenarios including lid and globe laceration and retrobulbar hemorrhage.

Decision-Support Technologies for Diagnosis of Trauma Patients: Major Hemorrhage and Traumatic Brain Injury
Jaques Reifman, Ph.D.
This talk will provide an overall description of our ongoing medical informatics research efforts as they relate to the development and deployment of decision-support technologies for diagnosis of trauma patients. In particular, it will describe: 1) a computational platform and artificial intelligent algorithms for real-time diagnosis of major hemorrhage, 2) an ongoing, prospective pilot project aimed at testing these technologies during the transport of critically ill patients to trauma centers, and 3) an our initial results of a retrospective analysis of vital-sign data for the characterization of traumatic brain injury.
I graduated from Stanford University and completed medical training, graduate training (Ph.D. in Neuroscience) and residency at UCSF. I subsequently completed clinical fellowship training in cornea and uveitis at UCSF and a post-doctoral research fellowship in viral pathogenesis at UCLA. I joined the faculty as an assistant professor at UCSF in 1991 and by 1999 was promoted to full professor, and Director of the F.I. Proctor Foundation, an organized research unit of the University of California, focusing on Infectious and Inflammatory Eye Disease. The focus of both my clinical practice and my research is on infectious and inflammatory eye disease, with a particular interest in herpesvirus infections of the eye and ocular surface disease.

Research in the Margolis laboratory at UCSF focuses on the establishment and maintenance of herpes simplex virus latent infection of the mouse trigeminal ganglion. Other significant research interests include epidemiology of infectious and inflammatory eye diseases and clinical trials research. My most recent clinical trials research is focused on the use of telemedicine to screen for CMV retinitis in patient’s with AIDS in underserved regions of the world.

I am currently Director of The Ralph and Sophie Heintz research lab, Director of the Ocular Clinical Microbiology Lab, hold the Rose B. Williams Chair in Corneal Research and am Director of the F.I. Proctor Foundation. I have served on NIH study sections, on NEI council, on the ARVO Board of Trustees and have served as president of ARVO, the largest professional organization for ophthalmic research. In addition I have served on a number of advisory councils for the NEI, as well as for other academic institutions. In addition, I am one of the Executive Editors of the American Journal of Ophthalmology.
Kraig S. Bower, MD, FACS is Associate Professor of Ophthalmology at Johns Hopkins University and the Director of Refractive Surgery at The Wilmer Eye Institute. He is a board certified ophthalmologist and specializes in refractive surgery, cornea and external diseases of the eye and anterior segment surgery. Dr. Bower is a retired Army Colonel, Medical Corps. Between 2001 and 2010, he was the Director of Refractive Surgery at The Walter Reed Army Medical Center and served as the Army’s Refractive Surgery Subject Matter Expert, advising the Army Surgeon General on laser refractive surgery and managing the Army’s Warfighter Refractive Eye Surgery Program. He continues to maintain active collaborations with numerous academic and research institutions in an ongoing effort to better understand and improve outcomes after trauma and surgery to the eye. His current research and clinical activities focus on anterior segment disorders and refractive surgery. Areas of particular interest include corneal wound healing after PRK and LASIK, ocular trauma, phakic intraocular lenses, treatment of keratoconus, and laser cataract surgery.
Randy Kardon M.D., Ph.D., an Iowa native, is tenured Professor of Ophthalmology and Director of the Neuro-ophthalmology Service at the University of Iowa and Veterans Administration Hospitals. He holds the Pomerantz Family Chair in Ophthalmology and is Director of the Iowa City Veterans Administration Center of Excellence for the Prevention and Treatment of Visual Loss. Dr. Kardon has published over 20 chapters, co-authored a textbook, published over 150 peer-reviewed journal articles, and is presently the Principle Investigator or co-PI on 8 major grants externally funded by the Veterans Administration, NIH, and the Department of Defense. He has had funding for his research from the Department of Veterans Affairs since 1990, and was one of the first ophthalmologists to receive a VA Career Development Award. He did most all of his training (undergraduate, combined M.D.-Ph.D, residency and two year fellowship in neuro-ophthalmology at the University of Iowa and started as faculty in Ophthalmology in 1989. Dr. Kardon currently teaches and mentors undergraduate students, medical students, and residents and has received a University of Iowa Collegiate Teaching Award for his teaching and commitment to education. He currently serves on the editorial board for Archives of Ophthalmology and the Journal of Neuro-ophthalmology. His main areas of current research interest include pupil physiology and clinical application, traumatic brain injury and its treatment, the therapeutic use of intravitreal growth factors in preserving vision in optic nerve and retinal damage, structure-function relationships in optic nerve disease, image analysis and telemedicine of the retina and optic nerve, and electrophysiology of the retina, including multifocal electoretinography. Current interests outside of work include health and fitness, golf, picking corn, and travel.
Ocular Pain

Ocular Pain: Framing the Clinical Issues
Todd Margolis, M.D., Ph.D.
The 2011 Institute of Medicine Report on Pain noted that greater than 110 million Americans suffer from some form of chronic pain. The total financial costs of this medical epidemic are $635 million per year, half in medical expenses and half in lost productivity. This is higher than the annual financial costs in for cancer, heart disease and diabetes combined. Ocular discomfort and pain, most commonly ascribed to dry eye or allergy, is the single most common reason that patients seek out Ophthalmic care. However, Ophthalmologists have no little or formal training in the diagnosis or management of ocular pain, and many of these patients get little or no lasting relief from topical agents targeting dry eye and allergy. This is unfortunate since incompletely treated acute pain gives rise to chronic pain, a maladaptive and learned condition of the central nervous system. There is no standardized ocular pain language (think about how the term ‘photophobia’ is used), no standardized approach to assess ocular pain and no concept of ocular pain as a disease entity. Neuro-ophthalmologists largely do not want to see these patients and multi-disciplinary pain clinics are not equipped to deal with them. Very recent changes within the field of Ophthalmology and at the National Eye Institute have begun to recognize the importance of further study of ophthalmic nociceptive pathways as well as ocular pain syndromes, especially common forms that derive from chronic ocular surface disease. The easily visualized anatomy of the cornea and accessibility of the ocular surface to pharmacological agents make the eye an ideal organ for the study of pain. It is also an ideal system for evaluating and treating pain, and there is not reason that we are not doing a better job of this.

Current Concepts in PRK Pain Management
Kraig S. Bower, M.D., F.A.C.S.
Photorefractive keratectomy (PRK) is a refractive alternative to LASIK. Post-operative discomfort is a major drawback after PRK and thus the management of pain and discomfort following PRK is of great importance. PRK results in a complex cascade of events that trigger sensory afferent fibers in the cornea and can produce various degrees of discomfort. Pain management strategies include the use of cold BSS during the procedure and the placement of extended-wear bandage contact lenses until reepithelialization occurs. In addition, the use of topical anesthetics and NSAIDS can be helpful when used judiciously. Oral analgesics, such as acetaminophen/codeine (Tylenol #3), oxycodone/acetaminophen, and NSAIDS are commonly used by practitioners. The use of oral medications approved for neuropathic pain, such as gabapentin and pregabalin, can also be used as adjunctive agents to minimize use of topical medications or oral narcotic agents. Opioid receptors and 5HT1D receptors have also been identified on the cornea and thus topical morphine and oral sumatriptan are being used. With the advent of new methods of analgesia targeting specific corneal sensory afferent nociceptors, patient discomfort can be minimized with less adverse effects on corneal healing.
New Approaches Toward Objective Evaluation and Treatment of the Most Common Symptom of TBI – Light Sensitivity

Randy Kardon, M.D., Ph.D.
Randy H. Kardon1,2A, Susan C. Anderson1,2A, Pieter Poolman1,2A, Jan M. Full1,2A, Andrew F. Russo2B, and Ana Recober2C

1Center for Prevention and Treatment of Visual Loss, Iowa City VA Healthcare System, Iowa City, IA; 2Ophthalmology and Visual Sciences, 3Molecular Physiology and Biophysics, 4Neurology, 5University of Iowa, Iowa City, IA.

Purpose: To determine if the photic-electromyogram (photic-EMG), an objective test of light sensitivity, shows an exaggerated response in patients with traumatic brain injury (TBI) and migraine, compared to normal subjects.

Methods: Ten patients with a diagnosis of light sensitivity from TBI or migraine headaches (but without headache at the time of testing) and eight normal subjects were tested using red (640nm) and blue (485nm) Ganzfeld, full field light, one second in duration, over a 6 log unit range of intensity (0.5 log unit steps). Time-stamped, computerized recording of the orbicularis and procerus muscle EMG were quantified and the maximum root mean squared (RMS) was compared between the patients and age matched control subjects.

Results: Patients had maximum photic-EMG response to the brightest red and blue lights (EMG RMS red mean=7.2+/-2.4 SEM, blue=6.7+/-2.1 SEM) which was significantly greater than normal control subjects (EMG RMS red mean=1.2+/-0.06 SEM, blue=1.5+/-0.23SEM) for either red light (p<0.001) or blue light (p<. 0.03). One migraine patient had near normal EMG responses, but was on pain medications. 2 of the 8 normal subjects appeared to have greater photic-EMGs compared to the remaining 6 subjects. On further questioning, one subject did have a history of weekly headache and the other admitted to light sensitivity.

Conclusions: This preliminary study demonstrated that the photic-EMG shows an exaggerated response in patients with TBI or migraine, indicating light sensitivity which may be mediated by the central trigeminal nucleus in the brainstem. The light induced EMG of the eyelid and procerus muscles may be a useful objective test of light sensitivity in patients and their response to treatment.

Supported by the Department of Defense (TATRC) Vision Research Program 11125001 and the Department of Veterans Affairs Rehabilitation Research and Development Division and the Iowa City VA Center for the Prevention and Treatment of Visual Loss.
Dr. Eric Pearlman is a professor in the Department of Ophthalmology and Visual Sciences at Case Western Reserve University. He received his undergraduate degree at the University of Glasgow, Scotland, his Masters degree from the Hebrew University of Jerusalem, and his Ph.D. in Microbiology from the University of Texas at San Antonio. Dr Pearlman’s research has focused on the immunology and microbiology of corneal infection diseases, working on the pathogenic mechanisms underlying corneal infections caused by pathogenic fungi and bacteria. These studies involve the use of animal models of infection, and examination of host response in infected individuals in south India, The long - term goal of Dr Pearlman’s work is to develop targeted approaches to treatment and prevention of infections and host mediated tissue damage that leads to corneal blindness.
Captain Jeffrey Blice, M.D.
Deputy Assistant to the Commander
Assistant Chief, Ophthalmology Service
Assistant Professor of Ophthalmology
Uniformed Services University of the Health Sciences
Walter Reed National Military Medical Center
Bethesda, MD

Dr. Jeffrey Blice received his MD degree from Temple University, School of Medicine in Philadelphia in 1988. He completed his residency in Ophthalmology in 1994 at the National Naval Medical Center in 1994. He completed his Vitreoretinal Surgery fellowship at Wills Eye Hospital in 1997. Since that time, he has been on staff at what is now the Walter Reed National Military Medical Center. He is an Assistant Professor at the Uniformed Services University of Health Sciences in Bethesda, MD. Although extensive obligated with administrative duties related to the strategic operations of the medical center, he maintains an active clinical practice and educational commitment. He has served in an operational setting with the 2nd Marine Division in support of the Persian Gulf War 1990-1991. He has extensive experience in the management of ocular trauma specifically related to combat.
Joseph Ciolino, M.D.  
Instructor in Ophthalmology  
Cornea and Refractive Surgery Service  
Massachusetts Eye and Ear  
Harvard Medical School  
Boston, MA

Joseph B. Ciolino, MD is a NIH-supported clinician-scientist, who studies ocular drug delivery and mechanisms of increasing keratoprosthesis retention. Dr. Ciolino received his bachelor's degree from Boston College, his medical degree from Georgetown University School of Medicine and performed an internship in internal medicine at Brown School of Medicine. He completed his residency at Albany Medical College and his cornea fellowship at Massachusetts Eye and Ear.

Dr. Ciolino is currently a full time faculty member of the Ophthalmology department at Mass. Eye and Ear where he serves as a member of the Cornea Service. Dr. Ciolino has been working with collaborators at Children's Hospital Boston and MIT on developing a drug-eluting contact lens.

In addition, Dr. Ciolino is on the Board of Directors for the Contact Lens Association of Ophthalmologists. He is a member of the Controlled Release Society and several ophthalmic associations including the Tear Film and Ocular Surface Society, Cornea Society, and Association for Research in Ophthalmology and Vision Science.
Dr. Suzanne Fleiszig received her PhD and OD degrees from the University of Melbourne, Australia. After completing a post-doctoral fellowship at Harvard Medical School she joined the faculty of the University of California, Berkeley, where she is currently Professor of Optometry & Vision Science, Microbiology, and Infectious Diseases & Immunity.

Dr. Fleiszig’s research program is focused on understanding the pathogenesis of, and developing new therapies for, corneal infection. Funding for her research has come from the NIH, the Bill and Melinda Gates Foundation, and through unrestricted funds from Industry.

Dr. Fleiszig is currently the Vice-President of the Tear Film and Ocular Surface Society and is on the Council of the American Society for Microbiology (ASM). She also serves on the Editorial Boards of several journals including PLoS ONE, Infection & Immunity, and Investigative Ophthalmology and Visual Science. In recent years Dr. Fleiszig has served as Division Chair for ASM, on the Program Committee for ARVO, as President of the International Society for Contact Lens Research, and as a standing member of the Anterior Eye Disease Study Section for the NIH. Dr. Fleiszig has been a recipient of the Borish Award (American Academy of Optometry), the Glenn Fry Award (American Optometric Foundation), and the Donald R. Korb Award (American Optometric Association).
Inflammation & Infection

Keynote: Neutrophils as First Responders in Corneal Infection and Inflammation – a Double-Edged Sword
Eric Pearlman, Ph.D.
The ocular surface provides an effective barrier against invasion by microbial pathogens. However, traumatic injury to the corneal epithelium disrupts these critical defense mechanisms, and allows penetration of invasive bacteria and fungi to the corneal stroma, resulting in infection that is frequently painful, debilitating and sight threatening. Neutrophils are the first cells that respond to bacterial and fungal invasion, and although they have an important role in microbial killing, release of proteases and reactive oxygen and nitrogen species in the corneal stroma also causes severe tissue damage, thereby contributing directly to loss of corneal structure and function. Recent advances in the understanding of neutrophil anti-microbial and immune regulatory activities will be presented in relation to invasive fungal and bacterial pathogens.

Endophthalmitis Prophylaxis: What are we doing?
CAPT Jeffrey Blice, M.D.
This brief lecture will review the military experience with the incidence of endophthalmitis for the duration of the Iraq and Afghanistan conflicts. Compare this experience to the incidence of traumatic endophthalmitis quoted in the literature. Methods of prophylaxis as they are currently recommended and carried out in the evacuation of patients from combat will be explained. Discussion of the unique features of the military experience and potential for altering current strategies for prophylaxis in general.

Contact Lens Drug Delivery
Joseph Ciolino, M.D.
We have developed a prototype drug-eluting therapeutic contact lens (TCL) that overcomes historical challenges such as the requirement for sustained drug release. For some patients, such a lens could possibly replace the need for eye drops, which are characterized by an inefficient drug delivery profile and notoriously poor patient compliance. Furthermore, a drug-eluting lens could greatly expand the treatment options for ocular diseases by improving topical medication efficacy, providing non-invasive delivery, simplifying treatment regimens, and allowing better patient compliance. In the military combat theater, a drug eluting contact lens could potentially be used after trauma to provide an eye with antibiotics and also relieve pain, which would allow a soldier to continue to function until receiving additional medical care. Post-trauma or post-surgically, the lens could be used to mitigate the risk of infection and possibly improve healing time. These drug-eluting contact lenses were created by encapsulating drug-PLGA (Poly[lactic-co-glycolic acid]) films in methafilicon A (a contact lens hydrogel) by ultraviolet light polymerization. In the bench top studies, the prototype contact lenses demonstrated an initial burst and then released a therapeutic amount of drug for 4 weeks duration. In the animal studies, the contact lenses were retained for one month with no signs of toxicity and latanoprost was detected in the anterior chamber at all time points throughout 1 month of lens wear. In summary, a contact lens for sustained drug release is indeed possible and could potentially be used as a platform for ocular drug delivery with widespread applications.
Towards "Green" Methods for Preventing Infection
Suzanne Fleiszig, O.D., Ph.D., F.A.A.O.

Presentation Description: The current approach to managing bacterial keratitis involves use of antibiotics for active disease, which does not necessarily prevent infection-related vision loss. While antibiotics can be used for prevention (prophylaxis) in a susceptible population, widespread use can result in resistance and toxicity. The goal of our research is to develop novel biocompatible prophylactics that function by targeting regulators of bacterial virulence or which restore natural corneal defense, rather than killing bacteria. These could be used in conjunction with contact lens wear, or after corneal trauma to protect against the risk of corneal infection. Accomplishing this goal requires a comprehensive understanding of how the cornea defends itself against infection when healthy, how susceptibility is enabled, and the regulators of bacterial virulence that participate in the earliest interactions with the corneal epithelium that eventually result in disease initiation. With this in mind, our laboratory has developed in vitro experimental models to mimic in vivo pathogenesis, in vivo models that allow early steps in pathogenesis to be studied, and methods for visualizing individual bacteria within intact live eyeballs at a subcellular level. Using array technologies and knockdown/knockout, we have begun to decipher critical virulence regulators that bacteria require to traverse susceptible corneal epithelium and host defenses that normally protect the epithelium against this. The results show a role for tear fluid in modulating epithelial immunity translating into a highly robust barrier against bacteria in vivo.
Telehealth, Telepresence & Informatics: Advanced Technologies

Ronald Poropatich, M.S., M.D.
Professor of Medicine
Executive Director
Center for Military Medical Research and
University of Pittsburgh

Colonel Ron Poropatich, MD is the Deputy Director of the Telemedicine and Advanced Technology Research Center (TATRC), of the US Army Medical Research and Materiel Command (USAMRMC) at Fort Detrick, MD which manages over $300 million/year in federally funded research in advanced medical technology. He also works towards wide-scale implementation of telehealth applications across the U. S. Army Medical Department in both stateside and overseas locations.

COL Poropatich is a Professor of Medicine at the Uniformed Services University of the Health Sciences in Bethesda, MD, and is the Chair of the NATO Telemedicine Expert Team. He is a former President and Board Member of the American Telemedicine Association and a practicing Pulmonary Medicine physician at the Walter Reed National Military Medical Center, Bethesda, MD. He currently serves as an Associate Editor for the "Telemedicine and e-Health Journal".

In July 2012, Dr. Poropatich will be retired from the US Army and assumes a new position at the University of Pittsburgh serving as the Executive Director for the Center for Military Medical Research and Professor of Medicine.
Francis L. McVeigh retired from the US Army in January 2008, as a Colonel after thirty plus years. He was the recipient of countless awards to include the Legion of Merit, ‘A’ Designator, and the Armed Forces Optometrist of the Year. Dr. McVeigh, O.D., received his B.S. from the University of Vermont, an M.S. from Pacific College of Optometry, an M.S. from the US Army War College and a Doctorate of Optometry Degree from the University of Houston College of Optometry. He is a graduate from the Command and General Staff Residency Course and the Army War College. He has held various positions in the Army to include Clearing Platoon Leader in the 1st Calvary Division, Chief of Optometry at the Wurzburg Hospital, Pentagon Clinic and Walter Reed Army Medical Center (WRAMC). Additionally, he served as the Pentagon Clinic’s Renovation Project Officer, the eye technicians’ program director at the Academy of Health Sciences; career counselor at the Army’s Personnel Command; and Optometry Consultant for Korea and the North Atlantic Regional Medical Command. Dr. McVeigh established the North Atlantic Regional Medical Command/WRAMC Clinical Informatics Divisions and was selected to be its first director. Additionally, he was the co-founder of the WRAMC Optometry-TBI Service. He has published countless articles, authored the History of Optometry and served as the President of the Armed Forces Optometric Society. Currently he is a member of many professional organizations’ executive committees and is the past Chairperson of the American Optometric Association’s Health Information and Technology Committee. In February 2008 Dr. McVeigh joined the Telemedicine and Technology Advanced Research Center (TATRC) as a senior clinical consultant/scientist for Telehealth and Vision. He serves as the Program Manager for the tele-Traumatic Brain Injury (TBI) programs to include mCare (cell phone initiatives with Community Based Warrior Transition Unit Soldiers); Transcranial Doppler (used to assess severe TBI patients’ cerebral vascular systems) and for the past four years has established over ninety telehealth sites with equipment and personnel for the Army Medical Department across nineteen time zones in Alaska, Hawaii, America Samoa, Continental United States and Europe for nineteen medical related areas which performed greater than 60,000 telehealth encounters over the last twelve months. Additionally, he provides consultation for eye/vision related research, and the ‘Hospital of the Future’ research initiatives. Furthermore, he serves as the Contract Officer Representative for the AMEDD TeleTBI/health Program, a Grant Officer Representative for several Eye/Vision Research Initiatives and a reviewer for the American Telemedicine Association’s Journal. Recently he was selected as the functional proponent for the Patient Centered Medical Home’s mobile applications and as of June 1, 2012 has assumed all TATRC Telehealth related responsibilities.
Lloyd M. Aiello, M.D.
Clinical Professor of Ophthalmology
Harvard Medical School
Investigator
Section on Eye Research
Founding Director of the Beetham Eye Institute
Joslin Diabetes Center
Boston, MA

Lloyd M. Aiello, MD is Clinical Professor, Department of Ophthalmology, Harvard Medical School, and Founding Director, Beetham Eye Institute, Joslin Diabetes Center.

Dr. Aiello pioneered laser treatments for diabetic retinopathy, has been a leading ophthalmologist in national clinical trials in diabetic retinopathy, and is an internationally recognized pioneer and leader in the care of diabetic eye disease.

Dr. Aiello is a leader in the field of telemedicine for diabetic retinopathy, co-founder of the Joslin Vision Network, and Medical Director for the Joslin Vision Network.
Jerry Cavallerano, O.D., PhD
Associate Professor,
Department of Ophthalmology, Harvard Medical School
Beetham Eye Institute Joslin Diabetes Center
Joslin Diabetes Center
Boston, MA

Jerry Cavallerano, OD, PhD is Associate Professor, Department of Ophthalmology, Harvard Medical School and Optometrist, Beetham Eye Institute, Joslin Diabetes Center.

Dr. Cavallerano is former Chair of the Ocular Telehealth Special Interest Group of the American Telemedicine Association, a recognized leader in the field of ocular telemedicine, and a co-author of the ATA's Telehealth Practice Recommendations for Diabetic Retinopathy. He serves as Chief, Beetham Eye Institute Center for Ocular Telehealth at the Joslin Diabetes Center.
Jay Shore M.D., M.P.H.
Associate Medical Director,
Colorado Physicians Health Program
Subject Matter Expert and Psychological Health Portfolio Manager
Telemedicine & Advanced Technology Research Center
Associate Professor
Department of Psychiatry
American Indian and Alaska Native Programs
University of Colorado
Domain Lead
Department of Veterans’ Affairs
Office of Rural Veterans Rural Health Resource Center
Denver, CO

Jay H. Shore, MD, MPH is an Associate Professor in the University of Colorado School of Medicine’s Department of Psychiatry and the School of Public Health’s Center for American Indian and Alaska Native Health. He is the psychological/behavioral health portfolio manager for the Department of Defense’s Telemedicine and Advanced Technology Research Center (TATRC) and leads the Native Veteran Domain for the Department of Veterans Affairs Office of Rural Health's Veterans Rural Health Resource Center_Western Region. Dr. Shore is a former Fulbright Fellow who received his medical and public health degrees from Tulane University School of Medicine and Public Health. After completing residency in general psychiatry at the University of Colorado he undertook an NIMH sponsored research fellowship examining the reliability and process of telepsychiatry with American Indian veterans.

Dr. Shore is currently participating in multiple telehealth projects which include ongoing development, implementation, and assessment of telehealth programs in Native, rural, and military settings aimed at improving both quality and access to care. He has been involved in telehealth consultation for tribal, state and federal agencies and authored a number of published manuscripts focused on clinical and research topics in telehealth. Dr. Shore has been a member of the American Telemedicine Association since 2000, and served on its board of directors, as well as being an active member in the TeleMental Health Special Interest Group for which he is the immediate past Chair.
Stephen G. Waller, M.D., F.A.C.S., is a 1983 USUHS School of Medicine graduate and an Associate Professor of Surgery and of Preventive Medicine there. He is a board-certified ophthalmologist with over thirty years of US Air Force service. He led the acquisition and policy for the first USAF refractive laser, and performed the first laser refractive surgery in an Air Force hospital.

Since completing his Air Force career, Dr. Waller has screened thousands of diabetic patients for retinopathy using a single-photo technique. He is author of 35 journal publications and six book chapters. His primary scholarly interests are in the evaluation of humanitarian operations and in tropical eye disease.
COL Robert A. Vigersky MC was the 1970 Valedictorian graduate of the pioneering 6-year Program in Liberal Arts and Medicine of Boston University where he was elected to Phi Beta Kappa and Alpha Omega Alpha. He did his Internship and Residency in Internal Medicine at The Johns Hopkins Hospital and then completed a 3-year Fellowship in Endocrinology at the National Institutes of Health becoming Board Certified in both Internal Medicine and Endocrinology and Metabolism. He remained on the staff at NIH for 2 years and then transferred to Walter Reed Army Medical Center where he became Assistant Chief of Endocrinology until 1984. He then entered the private practice of Endocrinology becoming the President of the Endocrine and Diabetes Group of Washington - a large, single specialty practice with 3 offices in the metropolitan Washington, D.C. area. He was the Medical Director of the Diabetes Treatment Center at Georgetown University Hospital and the Washington Hospital Center and was voted one of the Washingtonian Magazine’s Top Doctors in 1991, 1993, 1995, 1997 and 1999. In 2000, Dr. Vigersky re-entered the Army establishing the Diabetes Institute of the Walter Reed Health Care System of which he is the Medical Director.

COL Vigersky holds the “A” proficiency designation from the Department of the Army and received numerous military awards including the Legion of Merit in 2009. He was elected as a member of the Order of Medical Military Merit. He represents the Department of Defense on the Advisory Council of the National Institute of Diabetes, Digestive and Kidney Disease. He is a Professor of Medicine at the Uniformed Services University of the Health Sciences and received the James Leonard Award for Excellence in Teaching in 2003. COL Vigersky has served in Iraq, Korea, and Germany.

He is a leading researcher and sought-after speaker on the use of technology and decision-support systems to improve outcomes for patients with diabetes. He is an active participant in many professional organizations including The Endocrine Society where he served as its President from 2009-2010. He is known as the “father” of The Endocrine Society’s Clinical Practice Guideline program which has published 25 evidence-based guidelines in endocrinology over the last 8 years.

He has also been active in the Diabetes Technology Society who gave him its Leadership Award in 2011. In April 2012, he chaired the International Clinical Diabetes Technology meeting and will chair its International Hospital Diabetes Technology meeting later this year.

Dr. Vigersky has published 118 scholarly papers and 107 abstracts in his specialty.
**Telehealth, Telepresence & Informatics: Advanced Technologies**

**The U.S. Army Telemedicine Program – Making a Difference at Home and Abroad**

Ronald Poropatich, M.S., M.D.

Since initially establishing telemedicine capability for deployed US forces in Somalia in 1993, the US Army Telemedicine program has expanded significantly to both US based and overseas locations.

In 2004, a low cost email teleconsultation system for deployed service members was established and over time expanded to include more than 19 medical and 7 dental specialty services. The teleconsultation program has provided more than 10,000 store and forward consults to theater, serving more than 2600 deployed providers, avoiding costly medical evacuations while maintaining a 5 hour response time. In 2008 this program was extended to all NATO forces in Afghanistan and is in continued use.

In 2008, with heightened focus on Traumatic Brain Injury (TBI) and PTSD, a tele-TBI program was established. This effort provided equipment and personnel to each Army regional medical command and has grown to more than 91 sites across 21 time zones, providing telehealth encounters in 22 medical disciplines. More than 100,000 telehealth encounters were accomplished in FY10 and 11 and currently there are approximately 7000 consults/month. Ongoing evaluation of the program estimates at least $3M in cost avoidance by reducing travel costs, and more rapid access to care and better leveraging of resources across regions.

In 2010, a simple real-time interactive tele-behavioral health capability across Afghanistan, Iraq, and Kuwait was established with 72 active sites currently with plans to expand to 93 sites in Afghanistan alone. As of July 2012, over 2500 tele-behavioral consults from Afghanistan have been completed resulting in improved access to care for both patients and providers.

The U.S. Army Medical Research and Materiel Command at Fort Detrick, MD through the Telemedicine and Advanced Technology Research Center (TATRC) have a strong and established interest in mobile health with 12 established national and international mobile health projects in progress.

In 2009, TATRC created the cell phone based project “mCare” which connects injured warriors rehabilitating at their home locations with their remotely stationed case managers utilizing the soldier’s personal cell phone. This system uses a secure messaging HIPAA compliant format and from May 2009 to July 2012 provided more.

**Doctors Listen: The Balance of Power is Changing**

Francis McVeigh, O.D., M.S., F.A.A.O.

This talk will discuss the top telemedicine trends to include Bluetooth pills, mobile health clinics, real-time medical diagnosis systems, tele-pharmacy and other technologies and applications. Further, it will elaborate on the emergence of mobile health, its potential, demand, prevalence around the globe and the barriers and challenges needed to achieve success. It will discuss the many different disciplines getting involved in mobile health. It will discuss the hopes and concerns of mobile health from the providers, patients and payers’ perspectives and the possible change in the balance of power between the provider and patient. It will discuss eye related telemedicine applications. Lastly, it will discuss the Gartner ‘Hype Cycle’ which graphs the maturity of telemedicine technologies and applications between initial commercialization and broad market acceptance.
Expanding the Boundaries of Diabetes Eye Care
Lloyd Aiello, M.D. & Jerry Cavallerano, O.D., Ph.D.

Diabetic retinopathy remains a leading cause of new-onset vision loss worldwide despite proven methods to preserve vision. This presentation (1) emphasizes the importance of validation for telemedicine programs for diabetes eye care, (2) highlights the potential of telemedicine programs to extend access to evidence-based eye care, allow for focused patient education, offer alternative avenues of diabetes eye care, and integrate diabetes eye care with comprehensive diabetes care, and (3) proposes innovations that will make telemedicine for diabetes more available and effective.

Presentation Outline:
1. Background: Diabetes epidemic and diabetic retinopathy
2. Potential for telemedicine for diabetes and diabetic retinopathy
3. Validation of telemedicine programs for diabetic retinopathy—American Telemedicine Association Standards and Guidelines
4. Telemedicine for diabetic retinopathy
   a. Extend access to evidence-based care
   b. Offer alternative methods of care (requires validation)
   c. Provide focused education on DM/DR
   d. Integrate eye care with DM care
5. Future needs and directions

Keynote: Facilitating Meaningful and Effective Patient Interactions During Video Conferencing
Jay Shore, M.D., M.P.H.

Telemedicine, in the form of live interactive videoconferencing, has enormous promise to improve both the quality of and access to care for patients. A growing body of scientific evidence is demonstrating that meaningful and effective patient interactions can be conducted via telemedicine. However treating patients via telemedicine does change the nature of communication and has an impact on the provider-patient relationship. Providers need to be aware of the benefits and challenges of working with patients via videoconferencing including the importance of attending to communication style, environmental context and actively managing the clinical interaction. This talk will review these issues and proffer recommendations on adaptation of clinical style in the provision of high quality care via telemedicine.

Deploying a Diabetic Retinopathy Photo Screening System into a Large Health System: What is the Right Model?
Steven Waller, M.D., F.A.C.S.

The human suffering and financial costs of diabetic retinopathy in the US are spectacular and growing continuously. Part of the solution is an effective method of detecting early retinopathy, before vision-ending disease is untreatable. However, like most public health issues, the deployment of a screening system in a large health care system like the VA or military health system is complex. How do we balance the needs for quality and accuracy with convenience for the patient, low cost, and an experience that will incentivize the patient to be compliant with future recommendations? Dr. Waller will share his experience with several high-volume photo screening programs and describe some factors that may be decisive when a large health system determines to provide photo screening for retinopathy to its diabetic beneficiaries.
Use of Non-Mydriatic Retinal Screening to Improve Outcomes in Military Healthcare Beneficiaries

Robert Vigersky, M.D. F.A.C.P.

Non-mydriatic retinal imaging is a validated technology that is becoming widely adopted particularly in large HMO-like organizations because of its ability to effectively screen and triage patients to the appropriate level of care. Since the rate of diabetes and its complications is similar in military healthcare beneficiaries compared with the civilian population and they have similar poor (50%) compliance with recommended retinal screening as their civilian counterparts, non-mydriatic retinal screening performed in primary care clinics as another service in the Patient-Centered Medical Home represents an important approach in a cost-constrained environment. Over the last several years we have been involved in several efforts to improve the screening rate. We first validated the sensitivity and specificity of a non-mydriatic, stereoscopic retinal system (Topcon TRC-NW5S or NW6s)) in 243 patients using a telemedicine application involving 4 primary care clinics in the Washington, DC metropolitan area. We subsequently showed that this approach was cost-effective in large HMO-like organizations such as the Veterans Health Administration and Indian Health Service. Most recently, we have deployed a simpler non-mydriatic camera (Canon CR-1 Mark II) to 10 primary care clinics from Pennsylvania to North Carolina and established a reading center at Walter Reed to do large scale Category 1 screening for retinopathy using funding from the Office of the Army Surgeon General’s Advances in Medical Practice program. The next step in retinal screening is a self-administered application with automated retinal lesion detection. This would permit kiosk-based screening and eliminate the cost of a retinal imager. We have developed a pre-production model of a self-administered retinal camera, which is currently undergoing clinical validation.
Carlos Belmonte (Spain, 1943) obtained his MD and PhD degrees at the University of Madrid Medical School, where he became an Associated Professor in 1971. He has been afterwards Professor and Chairman of Human Physiology in the Medical Schools of Valladolid and Alicante, where he served as Vicepresident of the University and Dean of its Medical School. In 1990 he founded and directed until 2007 the Instituto de Neurociencias de Alicante, a joint Center of the University and the National Research Council (CSIC) that is the largest research institution in Spain devoted to the brain. He is now there head of a research group.

A former NIH International Fellow in USA, Dr. Belmonte has been a Visiting Professor at the Universities of Harvard, Utah (USA) and New South Wales (Australia). He is a member of the editorial board of the European Journal of Neuroscience, Experimental Eye Research, Pain and Molecular Pain, among others.

Dr. Belmonte is since 2008 the President of the International Brain Research Organization (IBRO). He has been President of the Spanish Society of Neuroscience, the International Society for Eye Research (ISER) and of the Spanish Society of Medical Education. He is a member of the Academia Europaea. Member of the National Academy of Sciences of Spain and of the Akademie der Wissenschaften und der Literatur, Mainz, Germany.

Dr. Belmonte obtained several national Prizes in Spain for his research in Neurosciences, presented by the Kings of Spain. In in eye research he has been awarded with the Alcon Research Excellence Award, the Endre A. Balazs Prize and the European Vision Award.

His research work has been centred on the functional study of ocular sensory innervation, ocular pain, transduction in sensory receptors and functional properties of primary sensory neurons particularly nociceptive and thermal neurons.
Dr. Elizabeth Hofmeister graduated with distinction from the United States Naval Academy with a degree in chemistry and received her Doctor of Medicine from Uniformed Services University of the Health Sciences. She completed an Internal Medicine Internship at the National Naval Medical Center (NNMC). Dr. Hofmeister received her flight surgery wings following Flight Surgery School in Pensacola, and she served as a flight surgeon on Marine Corps Base Hawaii. After her flight surgery tour, she completed ophthalmology residency training at Naval Medical Center San Diego (NMCSD). She completed fellowship training in Cornea and External Disease fellowship training at Wills Eye Hospital in Philadelphia. Since fellowship, she has served as a staff ophthalmologist at Naval Medical Center San Diego. She deployed to the Combined Security Transition Assistance Command Afghanistan/NATO Training Mission Afghanistan (CSTC-A/NTM-A) in 2009. At CSTC-A/NTM-A, she served as the Deputy Command Surgeon over a group of 125 mentors and advisors rebuilding the military medical system in Afghanistan. In December, 2009, she received the first “Building Stronger Female Physician Leaders in the Military Health System” award in the Junior Naval Officer category. The award honors outstanding female physicians who have made significant contributions to the practice of medicine and who have served as exemplary role models for other female physicians. She currently serves as the head of the Navy Refractive Surgery Center, San Diego, as well as the Refractive Surgery Advisor for Navy Ophthalmology.
Ocular Pain & Refractive Surgery

Keynote: Neural Mechanisms of Ocular Discomfort and Pain in Extreme Environmental Conditions
Carlos Belmonte, M.D., Ph.D.
The ocular surface is exposed to environmental temperature changes, injurious mechanical forces and irritant chemicals, which may threaten the integrity of eye tissues and ultimately the efficacy of visual function. To protect the eye, its outer coats are richly innervated by sensory nerve fibers originated at trigeminal ganglion neurons that detect potentially noxious stimuli reflexly activating different aversive responses. Sensory afferents reach the cornea and bulbar conjunctiva as thin myelinated or unmyelinated nerve fibers lacking of morphological terminal specialization. However, electrophysiological studies have shown that sensory neurons innervating the eye are functionally heterogeneous. Based upon their response to specific stimuli, different functional types of sensory nerve fibers have been identified. Mechanonociceptor fibers (~20% of the total) react only to mechanical forces; polymodal nociceptor fibers (~70%) respond to mechanical forces but also to heat, exogenous chemical irritants and endogenous inflammatory mediators. Cold-sensitive fibers (~10-15%) display an ongoing impulse activity at basal corneal temperatures and increase markedly their firing frequency with moderate cooling. Differences in transduction capacity among ocular sensory fibers are attributable to the variable expression of different types of transduction channels. Stimulation of the different functional populations of nerve fibers of the ocular surface in humans evokes sensations of specific quality including a variable component of unpleasantness. In addition to their role in the production of conscious innocuous and noxious sensations referred to the eye surface, sensory fibers play also a role in the maintenance of ocular surface homeostasis, including blinking, basal and reflex modulation of tearing and trophic maintenance of corneal and conjunctival tissues. Under sustained extreme environmental conditions or ocular pathologies (intense cold or heat, dryness, inflammation, surgical injury, abnormal tearing) ocular sensory neurons experience short- and long-term changes in ion channel density and expression leading to sustained changes in their spontaneous activity and altered responsiveness to natural stimuli which may elicit altered sensations (disesthesias) and disturbed ocular reflex responses. Supported by grants BFU2005-08741 and CONSOLIDER-INGENIO 2010 CSD2007-00023 from the Government of Spain.

Military Refractive Surgery: 2012 Snapshot
CAPT Elizabeth Hofmeister, M.D.
This talk summarizes current policy regarding military refractive surgery and provides demographics on the number of procedures performed over the past decade. Current practice patterns regarding preoperative evaluation, choice of procedure, surgical technique, and postoperative care will be discussed.
Blast Injury, Blast Eye

David Ritzel, M.A.Sc.
President & Senior Analyst
Dyn-FX Consulting Ltd.
Amherstburg, Ontario

Dave Ritzel holds a B.Sc (With Distinction) in Mechanical Engineering and M.A.Sc. in Aerospace Sciences. He began his career in blast research in 1978 with Defence R&D Canada (DRDC) at Suffield, Alberta, where his work covered wide-ranging computational modeling and experimental studies of blast phenomenology, effects on structures and materials, and personal vulnerability.

David became Head of Explosives Effects Group at DRDC Suffield in 1989; in 1995, he accepted a position with Weapons Systems Division of the Defence Science and Technology Organisation (DSTO), Australia where he became Head of Terminal Effects Group.

Mr. Ritzel has authored or co-authored over 60 reports on blast/shock research and was co-editor of NATO AEP-25 “Nuclear Blast and Thermal Test Methods and Procedures”; he has received numerous international awards and distinctions. In 2000 he formed his own consulting company based in Canada where his work has focussed on analysis of blast injury and blast protection of soldiers and civilians.
Dr. Rex began studying the retina while an undergraduate at Oakland University in Rochester, Michigan. She earned a B.S. in Biochemistry while working in Dr. Barry Winkler’s laboratory studying energy metabolism and oxidative stress in the retina. In 2001 she earned her Ph.D. in Molecular, Cellular, and Developmental Biology from the University of California Santa Barbara. Her dissertation research was performed in Dr. Steve Fisher’s laboratory on the molecular and cellular effects of retinal detachment on the photoreceptors. To complete her training, Dr. Rex performed a postdoctoral fellowship in the laboratory of Dr. Jean Bennett at the University of Pennsylvania. There she learned the techniques necessary for performing gene therapy in the eye for the treatment of inherited retinal degenerative diseases.

In 2007 Dr. Rex carried her passion for translational research on the retina to her first faculty position. From July 2007 until August 2012, she was a tenure track Assistant Professor in the Ophthalmology Department of the University of Tennessee Health Science Center. During that time she published several papers showing that erythropoietin, and a novel mutant of erythropoietin that her laboratory developed, is neuroprotective to the retina and optic nerve. She also developed multiple collaborations investigating the efficacy of the novel form of erythropoietin in other models of neurodegenerative disease. Further, she obtained a Department of Defense VRP Award to investigate and characterize a novel model of ocular blast injury that she and her collaborators developed. More recently, Dr. Rex was awarded a NEI R01 grant to study mechanisms and therapy for glaucoma. In August of 2012 Dr. Rex moved her laboratory to the Vanderbilt Eye Institute at Vanderbilt University where she has accepted a tenure track Assistant Professor position.
Dr. Marcus Colyer is a graduate of the United States Military Academy. He then earned his MD degree at the Pennsylvania State University College of Medicine in 2004. He began his post-doctoral training with a transitional internship at Walter Reed Army Medical Center where he also completed his Ophthalmology residency and served as chief resident between 2005-2008. He then completed a vitreoretinal diseases and surgery fellowship at Georgetown University/Washington Hospital Center/Retina Group of Washington in 2010.

Based primarily on his interest in the management of ocular trauma, Dr. Colyer has more than twenty publications to his credit as well as more than 30 abstracts and presentations. He has been an invited speaker nationally on the topics of endophthalmitis, ocular trauma, and complex retinal detachment repair. He is a member of the DoD Prevention of Combat Related Infections Task Force and has actively participated with the DoD-VA Vision Center of Excellence.
Dr. Cockerham is the National Program Director for Ophthalmology Services in the Veterans Health Administration, stationed in Palo Alto, CA. Previously, he was Chief of Eye Care Services at Palo Alto Health Care System. He is an Associate Professor (Affiliate) in Ophthalmology and Pathology at Stanford University.

Dr. Cockerham obtained his ophthalmology training at Walter Reed Army Medical Center, corneal fellowship training at Massachusetts Eye and Ear Infirmary, and ocular pathology fellowship training at the Armed Forces Institute of Pathology. He has been studying the effects of blast injury and neurotrauma on vision and ocular function since 2006.
Colonel Sheri De Martelaere, M.D.
Ophthalmology Service, Department of Surgery
San Antonio Military Medical Center
Fort Sam Houston, TX
United States Army

Dr. DeMartelaere was born and raised in Minnesota. In 1989, she graduated from the College of St. Benedict, St. Joseph, MN. In 1993, she completed medical school at the University of Minnesota, Minneapolis, MN.

Dr. DeMartelaere completed a Transitional Internship in 1994 at Tripler Army Medical Center, Honolulu, HI. She completed an Ophthalmology Residency in 1997 at the University of Colorado Health Sciences Center, Denver, CO. In 2006, she completed an ASOPRS Ophthalmic Plastic & Reconstructive Surgery fellowship at Texas Oculoplastic Consultants, Austin, TX, in association with the University of Texas.

Dr. DeMartelaere deployed with the 286th Eye Surgical Team in support of Operation Iraqi Freedom from March to October 2003. Dr. DeMartelaere has been assigned as the San Antonio Uniformed Services Health Education Consortium Ophthalmology Program Director since June 2009.
Dr. Goldstein is Director of the Molecular Aging & Development Laboratory, Center for Biometals & Metallomics, and Neurotrauma Laboratory at Boston University. He and his colleagues recently reported evidence of chronic traumatic encephalopathy (CTE), a tau protein-linked neurodegenerative disease, in the first case series of postmortem brains from blast-exposed U.S. military veterans and the youngest amateur football players studied to date (Goldstein et al., *Science Translational Medicine*, 2012). In the same study, his team discovered CTE neuropathology in laboratory mice two weeks after exposure to a single blast. Dr. Goldstein’s laboratory previously discovered Alzheimer’s disease Aβ amyloid pathology in the lens of the eye (Goldstein et al., *Lancet*, 2003), the first evidence of Alzheimer’s disease outside the brain. His laboratory predicted and confirmed AD-linked Aβ lens pathology as the molecular etiology of the distinctive cataracts in Down syndrome (Moncaster et al., *PloS One*, 2010). These findings led his team to develop an innovative diagnostic laser eye scanner that is now in clinical trial.

Dr. Goldstein received medical (M.D.) and doctoral degrees (Ph.D., Neuroscience) from Yale. He completed a clinical fellowship in adult psychiatry and a research fellowship in molecular neurobiology at the Massachusetts General Hospital. He joined the faculty at Harvard Medical School and established his laboratory at the Brigham & Women’s Hospital where he remained until his recruitment to Boston University in 2008.

Dr. Goldstein’s research has led to numerous patents, a successful biotechnology company (Neuroptix, Acton, MA), and the first FDA-approved ophthalmic drug-device diagnostic combination product. He has received awards from the National Institutes of Health, American Federation for Aging Research, Alzheimer’s Association, Harvard Medical School, and the Optical Society of America. Recent research support includes NIH, NSF, NASA, DOE, VA, Army Research Laboratory, Cure Alzheimer’s Fund, and Boston University.
Blast Injury, Blast Eye

Keynote: Blast Physics: In the Blink of an Eye...
David Ritzel, M.A.S.c.
Blast injury has come to the forefront of military medical research due to the unprecedented scale of soldier exposures to near-field explosions in the Iraq and Afghanistan conflicts particularly from IEDs (Improvised Explosive Devices). Although explosives have been used in munitions for centuries, the tactical situation in these current theatres has allowed an unequalled level of attacks at close range with such weapons. The low cost and high effectiveness of IEDs have made them the ‘weapon of choice’ for terrorists and insurgencies which will continue as a threat to US Forces both behind lines and in future deployments. Whereas some blast injuries to the eye are relatively straightforward, such as impacts due to projected fragmentation or ejecta, the blast wave itself can inflict unique injuries. The supersonic shock-front will pass over the skull within a millisecond and can impart not only severe transient pressures but extreme pressure gradients on the eye and optic nerve. Resolving such blast injuries requires at least a basic understanding of the physics of blast-wave interaction with the head which is a topic of concerted research. An overview of blast physics is presented as an introduction for biomedical researchers.

A Mouse Model of Ocular Blast Injury: Clinical Manifestations and Genetic Susceptibility
Tonia Rex, Ph.D.
The goal of this study was to characterize the effects of exposure to a primary blast wave on the eye on the tissue, cell, and molecular level. We built a blast device designed to direct a blast of compressed air to the eye of a mouse. It is composed of a paintball gun with a modified barrel, and a mouse housing chamber secured to an x-y stage. The input pressure can be set to a desired level and the output pressure is measured with a pressure transducer. Adult Balb/c, C57Bl/6, and DBA/2J mice were exposed to a single blast of compressed air at increasing pressure levels (0, 23, 26, 30psi). Mice were analyzed at increasing time points post-blast (0, 3, 7, 14, 28 days). Assessments included: gross pathology, intraocular pressure, optokinetics, optical coherence tomography, histology, and immunohistochemistry. Each wild-type strain of mouse responded differently to the blast. C57Bl/6 mice were the most resistant and DBA/2J mice were the most susceptible. Anterior segment damage included corneal edema, abrasions, and neovascularization, cataracts, and hyphema. Posterior segment damage included retinal detachments, vacuoles in the retinal pigment epithelium, epiretinal membranes, and optic nerve damage. Visual acuity decreased with time post-blast in some mice. TUNEL-positive cells and upregulation of GFAP were detected at 3 and 7 days post-blast primarily in mid-peripheral retina. Very few cells labeled with markers for apoptosis, indicating that most of the cell death occurred through an alternative route. In conclusion, exposure to a primary blast wave alone is sufficient to cause permanent damage to the neural retina and optic nerve. Genetic susceptibility factors likely control the extent of the response to blast exposure. With the power of mouse genetics we expect to identify druggable targets for the treatment of vision loss due to blast exposure and use our model as a platform for testing potential therapeutics.
Ocular Trauma at Walter Reed Army Medical Center: 2001-2011
MAJ Marcus Colyer, M.D.
Over 600 patients with eye injuries have been treated at Walter Reed Army Medical Center since 2001. Severity of injury, mechanism of injury, use of eye protection, surgical interventions, and visual outcomes and globe survival rates will be discussed.

Dry Eye Disease in Veterans with Neurotrauma
Glenn Cockerham, M.D.
A standard battery of dry eye tests was performed on 53 veterans with documented traumatic brain injury (TBI). The study cohort included 44 combat blast injuries; all subjects were male, with a mean age of 26 years. An age and gender-matched comparison group (n=18) underwent similar testing. Significant differences on the Ocular Surface Disease Index, a subjective survey of dry eye symptoms, were noted between the study group and published references without dry eye, as well as the comparison subjects. There were significant differences in the percentage of TBI subjects with any positive dry eye test (tear osmolarity, tear break-up time, ocular surface staining, tear production), versus the comparison group. Ocular surface staining was significantly different between the two groups. Positive dry eye tests did not correlate with TBI severity level, or mechanism of TBI. Removing subjects taking medications associated with dry eye from analysis did not change the overall results. TBI appears to be a predictor of dry eye disease (DED), despite the young age and male gender demographic of our study group. DED may account for some of the visual symptoms reported in TBI, and may complicate rehabilitation efforts. These findings should be validated in a larger series of neurotrauma patients, including further research into the pathophysiology and management of this condition.

Blast Injury and the Orbit
COL Sheri De Martelaere, M.D.
Improvised explosive device injuries have become the signature wound of the war against terrorism. The facial destruction from these devices results in macerated tissues imbedded with dirt and debris, comminuted bony injury, as well as tissue avulsion. Definitive care of these injuries often requires a multi-disciplinary approach and staging of reconstruction.
Chronic Traumatic Encephalopathy in Blast-Exposed U.S. Military Veterans and a Blast Neurotrauma Mouse Model: Implications for Military Eye Injury and Vision Research

Lee Goldstein, M.D., Ph.D.

Traumatic brain injury (TBI) resulting from exposure to explosive blast is the “signature” injury of the recent U.S. military conflicts in Iraq and Afghanistan. Blast TBI has been reported to affect ~20% of the 2.4 million military servicemen and women deployed to these conflict zones since 2001. Clinical features of blast TBI include persistent neuropsychiatric symptoms, long-term cognitive disability, and neurological sequelae that overlap with signs and symptoms of chronic traumatic encephalopathy (CTE), a progressive tau protein-linked neurodegenerative disorder associated with repetitive concussive injury in athletes (McKee et al., 2009, 2010). This talk will present new discoveries that link blast exposure to TBI and CTE in U.S. military veterans and a new blast neurotrauma mouse model (Goldstein et al., 2012). A three-year research effort was conducted by a large multidisciplinary team of experts in neuropathology, neurophysiology, behavioral neuroscience, biomedical engineering, and blast physics from across the nation. In the first part of the study, the team reported neuropathological evidence of CTE and axonal injury in the first case series of postmortem brains from U.S. military veterans with blast exposure and/or concussive injury. The CTE pathology in these brains was indistinguishable from the CTE pathology in comparison brains from the youngest amateur athletes with repetitive concussive injury studied to date. In the second part of the study, the team developed a new blast neurotrauma mouse model that reliably reproduces key features of blast-related brain injury in humans. Non-transgenic C57BL/6 mice exposed to a single sublethal blast (0% mortality) developed persistent CTE neuropathology—including accumulation of phosphorylated tau protein, axonopathy, microvasculopathy, chronic neuroinflammation, and neurodegeneration—that is strikingly similar to the human disease. Single blast exposure was sufficient to damage axons, nerve cells, and blood vessels that correlated with chronic neuroinflammation, slowed axonal conduction, defective synaptic plasticity, and impaired learning and memory. Surprisingly, these effects were observed within two weeks, persisted for at least one month, and emerged following exposure to a single blast. Precise measurements of shockwave transmission in the brain and high-speed kinematic analysis of head motion during blast exposure showed that blast-related brain injury was not caused by the shockwave and thoracic coupling as prevailing theories predicted, but rather resulted from the tremendous forces exerted on the head by the blast wind. Blast winds in this experimental system (or equivalent explosive blast) reach velocities of over 330 mph, far greater than the most extreme surface winds recorded on earth. Although brief in duration, blast winds violently oscillate the head at accelerations that damage neurons, nerve fibers, and small blood vessels in the brain. Intracerebral shearing forces induce focal and long-range brain injury that trigger neuroinflammation, neurobehavioral deficits, and CTE neuropathology. The pathogenic contribution of blast-induced head acceleration was confirmed by showing that head immobilization during blast exposure prevented long-term learning and memory deficits. Taken together, these results identify common biomechanical determinants leading to CTE neuropathology in military veterans exposed to blast and athletes with repetitive concussive injury, and additionally, provide mechanistic evidence linking head acceleration-deceleration cycling (“bobblehead effect”) to persistent blast-induced impairments in neurophysiological function, learning, and memory. The availability of a validated mouse model that recapitulates key features of human CTE is expected to: (i) open new avenues for investigation of mechanisms, biomarkers, and risk factors, and (ii) facilitate development of new diagnostics, therapeutics, and preventive measures for blast and impact neurotrauma and late-emerging sequelae. Implications for blast-related ocular injury will be discussed in the context of new results using our blast neurotrauma mouse model.

References

Dr. Bohdan Pomahac was born and raised in the Czech Republic where he graduated from Palacky University School of Medicine. He trained at Brigham and Women’s Hospital (BWH), Boston, in General Surgery and then went on to a fellowship in the Harvard Plastic Surgery Program. In 2004, Dr. Pomahac joined the staff at BWH, one of Harvard Medical School’s teaching hospitals, as a Plastic Surgeon and Associate Director of the Burn Center. Since January 2009, Dr. Pomahac has led the BWH Burn Center as Burn Director while also performing a broad range of plastic surgical and microsurgical procedures.

Dr. Pomahac established the Plastic Surgery Transplantation Program at Brigham and Women’s Hospital, the nation’s leading center in face transplantation. Dr. Pomahac led the nation’s first male face transplant procedure in April 2009 (only the second such surgery in the country) and in the fall of 2009 he was awarded a $3.4 million dollar contract from the Department of Defense to perform and investigate the outcomes of face transplantation. In March of 2011 he led the surgical team that performed the first full face transplant in the country and in April of 2011 the team completed their second full face transplant. Shortly after, in May, the team performed the first combined face and bilateral hand transplant procedure in the nation. In October of 2011, the team performed the first successful bilateral upper extremity transplantation in the Northeast.

As principal investigator of both the face and hand transplantation studies, Dr. Pomahac is currently working on several grants and clinical protocols as well as preparing patients for face and hand transplantation. His clinical interests include facial reconstruction, burn reconstruction, and microsurgery.
Budd A. Tucker, Ph.D., is an Assistant Professor in the Department of Ophthalmology and Visual Science at the University of Iowa. After obtaining his Ph.D. degree (2006) in neuroscience from the Memorial University of Newfoundland in Canada, under the supervision of Dr. Karen M. Mearow, Budd moved to Boston where he completed a Post-doctoral fellowship (2009) in stem cell biology at the Schepens Eye Research Institute, Harvard Medical School, under the supervision of Dr. Michael J. Young. Following his post-doctoral training, Budd joined the ranks of faculty at the Schepens Eye Research Institute, Harvard Medical School, where he focused on the use of stem cells for the replacement of lost retinal photoreceptor cells. In 2010, Budd moved to the University of Iowa where his research interests are focused mainly on the development of patient specific stem cell-based therapies for the treatment of blinding eye diseases. Budd has published several manuscripts/scientific abstracts relating to stem cell production, culture, isolation, differentiation and transplantation. Most recently, his group published a study focused on the production of adult retinal disease specific iPSCs and subsequent human photoreceptors for the purpose of disease modeling and elucidation of the disease mechanism (PNAS, 2011). In both studies, adult skin derived primary cells were essential for iPSC generation and subsequent experimentation. To date, his lab has generated in excess of 500 molecularly confirmed disease specific human fibroblast and keratinocyte cell lines, many of which have been reprogrammed to pluripotency and are now being used for disease modeling, in vitro gene therapy, drug screening, and cell transplantation studies.
Dr. Schwartz’ primary areas of research include early diagnosis and treatment of diseases such as macular degeneration, retinopathy of prematurity (ROP), and diabetic eye disease. Additionally, his focus includes development and evaluation of novel medical device technologies, imaging technologies, surgical equipment (including surgical robots), and drug delivery systems, with particular emphasis on diagnostic and treatment applications. Dr. Schwartz’ clinical research focuses on trials of novel pharmacotherapeutic agents to discover treatments for both wet and dry age-related macular degeneration, ROP, and diabetic retinopathy.

Through innovative teleophthalmological approaches to screen for eye diseases (such as diabetic retinopathy and ROP), Dr. Schwartz is dedicated to improving both the quality of and access to specialized ophthalmology care.

This year, Dr. Schwartz led two new clinical trials testing the use of stem cell-derived retinal pigment epithelial cells to address vision loss in people suffering from Stargardt's macular dystrophy and dry age-related macular degeneration.
Dr. Kaplan is the Evans Professor of Ophthalmology, Chair of the Department of Ophthalmology & Visual Sciences and Director of the Kentucky Lion’s Eye Center at the University of Louisville. He is a physician-scientist trained as a vitreoretinal surgeon and immunologist with an expertise in vitreoretinal diseases and uveitis.

Dr. Kaplan received his bachelor's degree from Columbia University (NYC) and his medical degree from Cornell (NYC). He served his residency in ophthalmology at the University of Iowa Hospitals and Clinics (Iowa City, IA), and his retina-vitreous fellowship at the Medical College of Wisconsin–Milwaukee. He was previously on the faculty of Emory University (Atlanta, GA, 1979-1988), where he served as Director of Eye Research, and Washington University (St Louis, MO, 1988-200), where he served as Chair of the Department of Ophthalmology from 1988-1998.
**Regenerative Medicine**

**Keynote: Facial Restoration by Transplantation**
Bohdan Pomahac, M.D.

Facial transplantation offers patients with devastating facial injuries a superior degree of functional and aesthetic restoration that is not possible with conventional reconstruction. To date, there have been 21 face transplants performed around the world. Our team at Brigham and Women’s Hospital (BWH), Boston represents the nation’s leading center in face transplantation. We have performed four of these facial transplants: 1 partial face transplant in 2009 and 3 full face transplants in 2011. Outcomes of patient 1 at three years post transplant and patients 2-4 at one year post transplant will be discussed. All four patients are currently doing wonderfully; they are all on a low dose immunesuppression regimen with no recent concerns of rejection. Outcome data including return of motor and sensory functions will also be presented.

Our current face transplant research is funded by a contract between BWH and the Department of Defense’s Biomedical Translational Initiative. Due to recent improvements in body armor, wounded warriors are surviving active combat at increasing rates, but a growing number suffer from severe facial injuries that cannot be adequately addressed by means of conventional reconstruction. We believe face transplantation is the only option that offers these wounded warriors the ability to reclaim their lives and place in society as well as return to active duty.

**Development of Stem Cell Based Therapies for the Treatment of Retinal Degenerative Disease**
Budd Tucker, Ph.D.

Retinal degenerative diseases such as Retinitis Pigmentosa (RP) and Leber's congenital amaurosis (LCA), which are characterized by dysfunction and/or death of the light sensing photoreceptor cells of the outer neural retina, are currently a major cause of inherited incurable blindness worldwide. RP and LCA gradually claim a person’s vision over many years and in some cases, also threatens the vision of family members. The heritability of RP, while one of its most frightening features, is also the means by which it may be cured. That is, the fact that the disease is caused by detectable variations in genes that are expressed in the retina will make it possible to: 1) prevent vision loss by early detection of the disease coupled with gene replacement therapy or some other form of treatment designed to block progressive injury to photoreceptors, and 2) create genetically corrected and immunologically matched photoreceptor precursor cells that can be transplanted into the retina to restore vision. By way of example I will discuss how induced pluripotent stem cells (iPSCs) have provided us with the newfound ability to interrogate inherited disease pathophysiology and develop patient specific gene and cell-based therapies for the treatment of retinal degenerative disease.
**Stem Cell Derived Retinal Transplantation: The First Human Experience**

**Steven D. Schwartz, M.D.**

**Background:** It has been 13 years since the discovery of human embryonic stem cells (hESCs). Our report provides the first description of hESC-derived cells transplanted into human patients.

**Methods:** We started two prospective clinical studies to establish the safety and tolerability of subretinal transplantation of hESC-derived retinal pigment epithelium (RPE) in patients with Stargardt's macular dystrophy and dry age-related macular degeneration—the leading cause of blindness in the developed world. Preoperative and postoperative ophthalmic examinations included visual acuity, fluorescein angiography, optical coherence tomography, and visual field testing. These studies are registered with ClinicalTrials.gov, numbers NCT01345006 and NCT01344993.

**Findings:** Controlled hESC differentiation resulted in greater than 99% pure RPE. The cells displayed typical RPE behaviour and integrated into the host RPE layer forming mature quiescent monolayers after transplantation in animals. The stage of differentiation substantially affected attachment and survival of the cells in vitro after clinical formulation. Lightly pigmented cells attached and spread in a substantially greater proportion (>90%) than more darkly pigmented cells after culture. After surgery, structural evidence confirmed cells had attached and continued to persist during our study. We did not identify signs of hyperproliferation, abnormal growth, or immune mediated transplant rejection in either patient during the first 4 months. Although there is little agreement between investigators on visual endpoints in patients with low vision, it is encouraging that during the observation period neither patient lost vision. Best corrected visual acuity improved from hand motions to 20/800 (and improved from 0 to 5 letters on the Early Treatment Diabetic Retinopathy Study [ETDRS] visual acuity chart) in the study eye of the patient with Stargardt's macular dystrophy, and vision also seemed to improve in the patient with dry age-related macular degeneration (from 21 ETDRS letters to 28).

**Interpretation:** The hESC-derived RPE cells showed no signs of hyperproliferation, tumorigenicity, ectopic tissue formation, or apparent rejection after 4 months. The future therapeutic goal will be to treat patients earlier in the disease processes, potentially increasing the likelihood of photoreceptor and central visual rescue.

**Funding:** Advanced Cell Technology.
**Photoreceptor Regeneration in Swine Model of Retinal Degeneration**

Henry Kaplan, M.D., F.A.C.S.

**Purpose:** A two-step protocol was developed for efficient differentiation of swine induced pluripotent stem cells (iPSC) into rod photoreceptors for transplantation into a swine model of rod photoreceptor loss.

**Methods:** Swine iPSC were derived from skin fibroblasts by lentiviral transduction of the stem cell specification genes *POU5F1, KLF4, SOX2* and *c-MYC*. These iPSC were then subjected to a two-step differentiation protocol consisting of floating culture as embryoid bodies followed by three weeks of differentiation in adherent culture. We examined the effect of substratum for adhesion culture and media composition on differentiation to rod photoreceptor lineage. Real time PCR and immunostaining were used to follow iPSC differentiation and the morphology of the cells was examined as well. We analyzed expression of the stem cell marker *POU5F1* and rod lineage markers including *RCVRN*, *NRL*, *RHO* and *ROM1*. Differentiated cells were then transplanted into the subretinal space of swine treated with iodoacetic acid to eliminate rod photoreceptors. Three weeks after transplantation, retinal sections were immunostained to follow engrafted cells.

**Results:** Real time PCR and immunostaining demonstrated loss of expression of the stem cell specification gene *POU5F1* and induction of rod photoreceptor gene markers including *RCVRN*, *NRL*, *RHO* and *ROM1*. Adherent culture on Matrigel led to a morphology resembling primary cultures of rod photoreceptors and to concentration of *RHO* and *ROM1* in outer segment-like projections. After transplantation, *RHO*+ cells were evident in all retinal layers, but they were concentrated in the outer nuclear layer where photoreceptors normally reside. A portion of these transplanted cells had projections resembling outer segments.

**Conclusions:** Skin-derived swine iPSC can efficiently differentiate to express markers of rod lineage and they morphologically resemble rods in culture concentrating *RHO* and *ROM1* into projections resembling outer segments. These cells can integrate into the outer nuclear layer following rod photoreceptor loss, and some of engrafted cells display outer segment-like projections suggesting transition to functional morphology.
Joseph Rizzo is a native of New Orleans, Louisiana and a graduate of Louisiana State University and Louisiana State University Medical School in New Orleans, where he received the "Dean's Award" in recognition of outstanding leadership and performance. He completed an internship in adult medicine at the University of California at Los Angeles Medical Center, followed by a neurology residency at Tufts University - New England Medical Center and then an ophthalmology residency at Boston University. He then performed a clinical fellowship in neuro-ophthalmology under Dr. Simmons Lessell in the Harvard Medical School Department of Ophthalmology at the Massachusetts Eye and Ear Infirmary. He is Board-Certified in both ophthalmology and neurology. Following completion of clinical training Dr. Rizzo joined the full-time academic faculty at the Massachusetts Eye and Ear Infirmary and received a five-year Physician Training Award from the National Institutes of Health. The laboratory training was under the supervision of Richard Masland, Ph.D.

Dr. Rizzo initiated the Retinal Implant Project in 1988 and since then has divided his professional time equally between the evaluation of patients with neuro-ophthalmologic disease and serving as co-director of the Retinal Implant Project. Dr. Rizzo has served as Director of the Neuro-Ophthalmology service at Harvard Medical School since 2006.

Dr. Rizzo and his wife, Sarah, live in Newton, MA. They have two children: Isabella (age 9) and Ava (age 5).
Bradley Greger received his Bachelor of Arts degree in philosophy in 1994, then a Bachelor of Science degree in biology in 1995, from Washington State University. As a graduate student at Washington University in St. Louis, he developed an interest in studying neuronal encoding in primates and humans. After earning his Ph.D. in 2001, he moved to Caltech as a postdoctoral research fellow where began investigating the use of microelectrode arrays in neural prostheses. He joined the Department of Bioengineering at the University of Utah in 2006, and has adjunct appointment in the Departments of Ophthalmology and Electrical & Computer Engineering. He is working on restoring lost vision using chronically implanted arrays of micro-electrodes for micro-stimulation of the primary visual cortex. The goal of this vision prosthesis project is to determine if patterns of microstimulation delivered to the primary visual cortex can evoke useful visual perceptions in profoundly blind human patients. These studies are currently being conducted in nonhuman primate models using systematic psychophysical testing to various parameters of cortical microstimulation. This work is transitioning to studies with human patients where their subjective descriptions of the evoked visual perceptions with enable more subtle experiments and a determination of the level of vision that can be restored.
Anil K. Raj, M.D., is a Research Scientist, Florida Institute for Human and Machine Cognition, Pensacola, Florida. He received his B.A. and M.D. from the University of Michigan. Following an internship in General Surgery, he completed a two-year fellowship as a National Research Council Resident Research Associate at the NASA-Johnson Space Center, Houston, TX. His interests in aerospace medicine research led him to the Naval Aerospace Medical Research Laboratory in Pensacola, FL.

Dr. Raj's research since joining IHMC in 1996 centers around the human physiologic and psychological responses to external forces (physical and psychological), particularly how they affect individual and team situation awareness and performance. He has been involved with the development, test and evaluation phases of the US Navy/NASA's Tactile Situation Awareness System (TSAS), and directed the first helicopter and first Unmanned Aerial Vehicle flight tests of TSAS. Dr. Raj focuses on the development of human centered interfaces for robotics and other man-made systems, assistive technologies for the disabled, automated systems for tracking, analyzing, manipulating and augmenting human behavioral response characteristics in dynamic environments, and high-dimensional psychophysio-logic data modeling of human brain function.
Restoring the Functional Eye

Visual Prosthetic Approaches to Visual Restoration After Traumatic Injury
Joseph Rizzo, M.D.

Military personnel are exposed to traumas that can compromise brain function in general and visual function in particular. Trauma often produces disabilities that are permanent, and therefore treatment options should include strategies that potentially can restore lost function. Post-traumatic blindness is one form of significant disability for which there are currently no treatments. Visual prosthetic devices have the potential to restore vision in these situations because of their ability to stimulate neural tissue that had not been damaged by the trauma. This presentation will review the status of the field of visual prosthetics, and our own Boston Retinal Implant Project. The collective achievements of various teams and companies in this field make it clear that crude vision can be restored to patients who have been legally blind for decades from retinitis pigmentosa. The challenges in providing higher quality vision in cases of traumatic injury will be reviewed.

Perceptual Characteristics of V1 Microstimulation via an Array of Microelectrode at Greater than 18 Months of Implantation
Bradley Greger, Ph.D.

It has been hypothesized that a vision prosthesis capable of evoking useful visual perceptions can be based upon electrically stimulating the primary visual cortex (V1) of a blind human subject via penetrating microelectrode arrays. We examined several spatial and temporal characteristics of microstimulation using an array of 100 penetrating microelectrodes chronically implanted in V1 of a behaving macaque monkey. After two years implantation we were able to evoke behavioral responses to electric stimulation across the spatial extent of the array using groups of contiguous electrodes. Consistent responses to stimulation were evoked at an average threshold current per electrode of 204 ± 49 μA (mean ± std) for groups of four electrodes and 91 ± 25 μA for groups of nine electrodes. Saccades to electrically-evoked targets using groups of nine electrodes showed that the animal could discriminate spatially distinct percepts with groups having an average separation of 1.6 ± 0.3 mm (mean ± std) in cortex and 1.0 ± 0.2 degrees in visual space. These results demonstrate chronic perceptual functionality and provide evidence for the feasibility of a cortically-based vision prosthesis for the blind using penetrating microelectrodes.
Sensory Substitution for Functional Vision Restoration
Anil Raj, M.D.
Sudden loss of vision can overwhelm a previously healthy warfighter’s ability to interact with the world, adversely impact the servicemember’s recovery from physical and psychological trauma, and preclude a return to the community as a productive, stable member of society. The Florida Institute for Human and Machine Cognition has developed an Anthro-Centric Multisensory Interface vision augmentation/substitution (ACMI-VAS) system that could allow recently blinded individuals to perceive of the visual environment. The ACMI-VAS project integrated three non-invasive tactile sensory substitution displays to simultaneously provide a partial substitution of the foveal, parafoveal and peripheral visual functions of the retina to recently blinded individuals. The ACMI-VAS concept employs tactile displays worn on the torso, abdomen and tongue that substitute tactual representations for visual data gathered from video and optical sensors. The ACMI-VAS software preprocesses the data stream to reduce clutter and sensor artifacts. ACMI-VAS allows blind individuals to navigate unfamiliar spaces while avoiding obstacles, read printed text, surf the Internet and identify colors. ACMI-VAS prosthetics would augment the sensory experiences of blind servicemembers following traumatic vision injury while avoiding the risks associated with invasive implantable devices.
Poster Abstracts
Title: Natural language processing to objectively assess information acquisition from video

Authors: Russell L. Woods, Peter J. Bex, Daniel R. Saunders

Affiliation: Schepens Eye Research Institute

Background: Information must be acquired from a video to understand its content. Visual acquisition of information from video is affected by degradation both of the video and of the observer’s vision. Currently, there is no widely accepted method of assessing this information acquisition, which may be related to perceived video quality.

Aim: To develop a technique in which free recall responses to a video are used to measure the amount of information that was acquired.

Method: Using 200 video clips of 30s duration, we prompted (1) normally-sighted viewers in the lab to verbally report; and (2) Amazon.com Mechanical Turk workers to write what they could recall immediately after watching each video clip. We collected responses from up to 40 viewers per clip, which became the normally sighted baseline. Information acquisition of a new viewer can then be estimated by comparing their response with the baseline responses to the same clip. Several methods for performing this comparison were evaluated based on how well they could match responses to the video clips they described.

Results: The shared-word similarity metric had the best performance, with 95% accuracy at matching a response to its video clip, and so was chosen as the primary means of scoring responses. The age and gender of the participants, but not the education level, significantly affected these scores.

Conclusion: We present a novel, objective measure of information acquisition from video and validate its results. The method could be used to evaluate both the impact of low vision on viewing video, and the effects of video enhancement techniques for people with low vision. It may be useful in evaluations of cognitive impairment.

Author Disclosure: Supported by NEI Grant R01EY019100
Title: Development and Preliminary Evaluation of a Video-Based Detection Test for Homonymous Visual Field Loss

Authors: Laura Werner¹, Karen Jeng², Amy Doherty³ and Alex R. Bowers¹,³

Affiliation:
1. New England College of Optometry, Boston, MA
2. Robert Wood Johnson Medical School, Piscataway, NJ
3. Schepens Eye Research Institute, Mass Eye and Ear, Harvard Medical School, Boston, MA

Background: Homonymous visual field loss (HVFL), a severe visual consequence of stroke and traumatic brain injury, causes difficulties in detecting objects on the blind side. Conventional visual field measures do not evaluate a patient’s ability to use their remaining vision; they simply quantify the extent of the field loss. We previously implemented a driving-simulator pedestrian detection task that has proven sensitive to the detection deficits of HVFL patients. However, simulators are costly, and not feasible for clinical use.

Aim: Our goal was to develop and evaluate a simple, inexpensive video detection test (based on our simulator test) that in the longer term could be used as an outcome measure for multicenter clinical trials of HVFL treatments.

Method: Videos recorded directly from our driving simulator were used to create 3-minute sequences in which pedestrians appeared and walked toward the road in a variety of situations. To date, 12 patients with HVFL have each watched 5 sequences (60 pedestrians) on two occasions, pressing a response button whenever a pedestrian was seen. Free eye movements were permitted. Seven patients also completed the same detection task in the driving simulator.

Results: As expected, detection rates were lower and reaction times longer on the blind than the seeing side in both video and simulator tests (p < 0.05). Test-retest repeatability on the video test was good for 9 participants (mean difference in blindside detection rates of 3% ± 4% between tests 1 and 2). In preliminary analyses, performance on the video test was predictive of performance on the simulator test for the majority of patients.

Conclusion: Initial results are promising, suggesting that our video test is repeatable and predictive of performance in a more complex task. A larger sample study is warranted to confirm these findings.

Author Disclosure: Funded in part by: TATRC Military Vision Research Program, Proposal 11066002 (subtask 10), and NIH grants EY018680 and 5T35EY007149
Title: Dose response effects on a measure of information acquisition from video

Authors: Daniel R. Saunders, Peter J. Bex, Russell L. Woods

Affiliation: Schepens Eye Research Institute

Background: We developed a new, free-recall-based measure of information acquisition from video, which is applicable to assessing video quality and vision disorders.

Aim: To evaluate this measure by testing its ability to distinguish the effects of different levels of blur, a simple simulation of a vision disorder.

Method: Twenty video clips were chosen from the set that was previously used to collect normative responses. In two experiments, subjects viewed these clips in random order, and their free-recall descriptions of the clips were scored by counting the number of words shared with the normative responses. The first experiment blurred the video clip by processing them with Gaussian low-pass filters. Five levels of blurring were included. Amazon Mechanical Turk workers (N = 49) provided written responses. In the second experiment, participants in the lab (N = 15) viewed the original clips through five defocus lenses that produced visual acuities from 20/20 to 20/800 logMAR. In this experiment they provided verbal responses.

Results: Greater degradation of the image produced a greater reduction in the measure of information acquisition. A mixed-model analysis showed that the highest levels of blur were associated with significantly lower average free-recall scores than the unblurred condition. Similarly, the strongest defocus conditions produced significantly lower scores than the normal acuity condition.

Conclusion: The free-recall measure was correlated with the amount of information that was available to the viewer in the videos. Therefore, this objective measure can be applied to assess impacts of vision disorders on video viewing. It may also be useful as a measure of cognitive function.

Author Disclosure: Supported by NEI Grant R01EY019100
Poster #4

Title: Development of a Vision Assistive Device for Patients Suffering from TBI Related Visual Field Loss

Authors: Shrinivas Pundlik, Matteo Tomasi, Gang Luo

Affiliation: Schepens Eye Research Institute, Massachusetts Eye and Ear, Harvard Medical School, Boston MA

Background: Traumatic brain injuries (TBI) affect thousands of soldiers on battlefields and millions of civilians (car accidents and strokes are major causes). Cognitive vision loss, such as hemianopia (loss of vision on the half side in both eyes) and even tunnel vision (complete loss of peripheral vision), is one of the serious consequences of TBI, which greatly impair safe and efficient mobility and often cause secondary injuries.

Aim: To develop a novel vision assistive system that detects potential obstacles in the blind field of the patients as they walk, and gives warning messages via audio in the event of an impending collision.

Method: We process the video stream obtained from a video camera, and based on the optical flow pattern obtained in the video, we localize the obstacle and determine the collision risk based on time-to-collision and collision point. A warning is issued if the collision risk is determined to be greater than a preset threshold. A prototype of a portable system has been developed.

Results: We have tested the collision detection algorithm using various simulated and real world scenarios, including stationary and moving camera for stationary and moving obstacles. The algorithm can successfully judge collision risk in real time. An assessment study with patients is in planning stage.

Author Disclosure: None
Title: Clinical Application of A Novel Contrast Sensitivity Test to a Low Vision Population

Authors: Lesmes, L.A. (1,2), Wallis, J. (2), Lu, Z-L (3), Jackson, ML. (2), Bex, P.B (1,2)

Affiliation: (1) Schepens Eye Research Institute, (2) Massachusetts Eye and Ear Infirmary, (3) The Ohio State University

Background: The contrast sensitivity function (CSF) characterizes functional vision, but its measurement is too time-consuming for clinical practice. The quick CSF method, (Lesmes et al, JOV, 2010), is a novel adaptive method that combines Bayesian adaptive inference and a trial-to-trial information gain strategy to efficiently estimate the full shape of the CSF.

Aim: Our goal was improve the clinical utility of the quick CSF method, apply it to assess spatial contrast sensitivity in a low vision population, and compare its results to standard clinical vision measures.

Method: For 21 patients referred to low vision rehabilitation, we measured the spatial contrast sensitivity function, from frequencies of .33 to 20.25 cycles per degree, in addition to Pelli-Robson contrast sensitivity, and logMAR acuity. The quick CSF algorithm was used to select the stimulus frequency and contrast presented on each trial. The full CSF was estimated from 15 quick CSF trials, from which two summary metrics were calculated: (1) the area under the log CSF (AULCSF), which provides a global contrast sensitivity measure, and (2) CSF acuity, a high frequency metric that defines the spatial frequency at which sensitivity = 2 (contrast threshold = 50%).

Results: The AULCSF estimates obtained with the quick CSF were correlated with Pelli-Robson sensitivity (r=.67), CSF acuity was correlated with logMAR acuity (r=-.69), but Pelli-Robson sensitivity and logMAR acuity were not correlated (r=-.14). AULCSF estimates obtained with 15 trials were the same as those obtained with 30 trials (mean difference = 2%; s.d.= 18%).

Conclusion: This computerized, monitor-based test can sample stimuli more precisely and with greater flexibility than cards or charts, while automating the processing of patient responses. This study demonstrates that with as few as 15 trials, which last 1-2 minutes, the quick CSF provides a reasonably detailed assessment of visual function in people with low vision.

Author Disclosure: LAL, Z-LL, and PB disclose intellectual property interest.
Poster #6

Title: A Novel Method of Assessing the Visual Ability of Elite Vision Subjects – Applicability to Military Personnel

Authors: Daniel M. Laby, MD, David G. Kirschen, OD, PhD, and Robert W. Massof, PhD

Affiliations: DML: Department of Ophthalmology, Harvard Medical School; DGK: Jules Stein Eye Institute, University of California, Los Angeles and Southern California College of Optometry, Fullerton, CA; RWM: The Wilmer Eye Institute, The Johns Hopkins School of Medicine

Background: Assessing the full visual performance in those who need exceptionally good vision is impossible using standard clinical techniques. A novel method of testing was developed for elite athletes that has direct applicability to military.

Method: Visual performance was measured in 184 Major League Baseball players during the 2012 spring training baseball season using a newly developed technique that takes into account the interactive effects of target size, contrast, and presentation.

Results: Mean visual acuity was 20/16.47. The mode, median and best visual acuity measured were all 20/10.26, worst visual acuity was 20/200. Using item response theory, a Core Score representing a composite of the three parameters was developed. Values ranged from -2.30 (worst) to 3.88 (best). Mean Core Score was 1.22 +/- 0.99. In addition to several other measures, three-dimensional vision threshold surfaces were created and geometric summary statistics were calculated for each of the parameter thresholds. The average visual performance was significantly better in elite athletes than in the general population and minor league athletes. This technique identified athletes with visual deficiencies who tested normally on standard tests of visual acuity. More importantly, it was able to delineate the specific nature of the problem by distinguishing between those with defocus problems, deficits in contrast detection, and those sensitive to brief presentation times.

Conclusion: The sensitivity, specificity and precision of this new technology enables detection of subtle, yet critical, visual abnormalities that are missed by standard vision testing. The test has direct applicability to the military in that it provides a more complete assessment of Visual function especially for those who’s assignments require fast, accurate and precise vision.

Author Disclosure: Drs. Laby and Kirschen have a financial interest in this material.
Title: Rapid and precise contrast sensitivity assessment on a tablet device

Authors: Michael Dorr¹, Luis Lesmes¹, Zhong-Lin Lu², Peter J Bex¹

Affiliation: (1) Schepens Eye Research Institute, (2) Ohio State University

Background: Visual function, such as contrast sensitivity, is typically assessed using laboratory setups with dedicated equipment that is large, cumbersome, and expensive. Cathode ray tubes (CRT) with video attenuators are still being used for precise stimulus control because digital display devices such as Thin Film Transistor (TFT) panels suffer from limited luminance and spatio-temporal resolution. Furthermore, standard tests of contrast sensitivity require a large number of trials and thus a long test duration.

Aim: To overcome these issues and develop a tablet-based test of contrast sensitivity that can be used quickly and outside the laboratory.

Method: We implemented the quick CSF algorithm (Lesmes et al., Journal of Vision 2010) on an Apple iPad tablet device. This algorithm reduces testing time to 15-25 trials by selecting the most informative stimulus based on a parametrized CSF. We further developed a novel, efficient algorithm to extend the display's luminance resolution from a minimum contrast of 1.12% to 0.1%. We evaluated system performance by comparing estimated CSFs with those obtained with a laboratory-grade CRT.

Results: Repeated measurements from four observers with normal/best-corrected and optically blurred (+4D) vision showed that reliable CSF estimates with peak sensitivities of 0.6-0.8% can be obtained in 5-7 minutes and that these estimates are indistinguishable from those obtained with specialized hardware.

Conclusion: Our system enables rapid and precise measurements of contrast sensitivity inside and outside the laboratory, for example to collect population data, closely monitor the progression of visual neuropathologies, and improve eye care delivery in medically underserved areas and the theater of war.

Author Disclosure: LL and ZL disclose an intellectual property interest in an issued patent (LL, ZL: USPTO #7938538) and a provisional patent (MD, LL, ZL, PB).
Poster #8

Title: Detection of Hazards in Driving Videos with a Monocular Bioptic Telescope

Authors: Amy Doherty, Eli Peli, Gang Luo

Affiliation: Schepens Eye Research Institute, Mass Eye and Ear, Harvard Medical School, Boston, MA

Background: The ring scotoma of a bioptic telescope has been proposed as a danger possibly impacting detection of traffic hazards when looking through the telescope while driving. Our previous study found that monocular bioptic users were able to detect targets in the area of the ring scotoma in a perimetry setup, which used an artificial checkerboard stimulus.

Aim: Extending the previous work to more realistic conditions, this study evaluates the ability of bioptic users to detect traffic hazards in driving videos.

Method: 6 subjects (3 bioptic and 3 normal vision drivers) watched video clips taken from a UK Hazard Perception Test and performed 2 simultaneous tasks: read aloud letters detected amidst a temporal series of numbers, and pressed a response button if they detected potential traffic hazards, which occurred at a 54% chance when letter stimuli appeared. Letters were positioned so that the hazard appeared in the ring scotoma area when reading the letter through the bioptic. Video clips included potentially hazardous events requiring the camera car to brake or change direction. Each participant completed 3 test conditions: baseline without letters, large letters to be read without the bioptic, small letters to be read through the bioptic.

Results: There were no significant differences in detection rates between reading letters with and without the bioptic (median 65% vs 83%, p=0.144). There was also no significant difference in reaction time detecting hazards (median 3.84 vs 3.79 sec, p=0.463). There was a significant increase in reaction time from baseline to reading letters with the bioptic (median 3.2 vs 3.84 sec, p=0.028).

Conclusion: These preliminary results suggest that bioptic and normal vision drivers are able to detect realistic hazards in motion videos while reading letters through a bioptic. These results are promising for bioptic drivers but further testing with more drivers is needed.

Author Disclosure: Supported by NIH grant AG034553
Title: Considering Optical Scotomas when Prescribing Prisms for Peripheral Visual Field Loss

Authors: Henry Apfelbaum, Nicole C. Ross, and Eli Peli

Affiliation: Schepens Eye Research Institute, Harvard Medical School, Boston, MA

Background: When conditions such as retinitis pigmentosa shrink the available peripheral field diameter, mobility becomes a problem, as both orientation and awareness of hazards become difficult. Locating lost objects also becomes challenging. Several styles of prism spectacles have been introduced to aid people with this loss, but there has been little long-term acceptance of these aids by patients. Prisms induce an optical blind area at their apex – the apical scotoma – equal in extent to the prism power.

Aim: We describe the limitations that phenomena like the apical scotoma represent in these devices and can partially explain their limited acceptance. Goldmann scans illustrate the effects at significant gaze angles, and we introduce a new “percept” diagram to give a patient’s-eye-view of the associated perceptual confounds.

Method: Percept diagrams and simulated dichoptic Goldmann visual field scans were calculated and plotted for unilateral and bilateral fitting of Inwave Channel Prism spectacles and (always unilateral) Peli Trifield spectacles.

Results: Channel prisms offer no field expansion at primary gaze. When gaze is shifted into the prisms the apical scotomas block important pericentral regions. The scotoma effect can be overcome by unilateral fitting, at the expense of induced visual confusion. Trifield prism spectacles provide true field expansion at all gazes but do so while inducing central visual confusion.

Conclusion: The low prism powers used for channel prisms, apical scotomas and ineffectiveness at primary gaze can explain the lack of significant acceptance by patients. The central confusion of Trifield prisms has led to limited acceptance, despite their more significant expansion capabilities. Any future success fitting prisms for symmetric field loss will likely require configurations that avoid central confusion yet still make use of remaining peripheral vision at primary gaze.

Author Disclosure: None.
Poster #10

Title: Scanning and detection of static and moving pedestrians by drivers with hemianopia in a simulator

Authors: Concetta F. Alberti, P Matthew Bronstad, Alex Hwang, Amanda Albu, Egor Ananev, Robert Goldstein, Eli Peli, Alex R. Bowers

Affiliation: Schepens Eye Research Institute, Massachusetts Eye and Ear Infirmary, Department of Ophthalmology, Harvard Medical School, Boston, MA.

Background: In our previous simulator study of drivers with hemianopia (Bowers et al., 2009), we reported large detection deficits for stationary pedestrians that appeared in the blind hemifield.

Aim: Using a more realistic hazard, we are now evaluating detection of pedestrians that move on a collision course toward the car’s heading direction. We predicted that blindside detection rates would be higher for moving pedestrians (as they maintain an approximately constant eccentricity with respect to the car) than for static pedestrians (eccentricity of the pedestrian increases rapidly as the car approaches, thus moving the hazard further into the blind hemifield). In addition, we are evaluating the relationship between gaze behaviors and detection performance.

Method: 12 participants with complete homonymous hemianopia have performed the pedestrian detection task while driving along 10 pre-determined routes. Static and moving pedestrians were presented in two sessions. The proportion of untimely detections (either failed to detect or reaction time was too long to avoid a potential collision) was calculated for each participant. Eye and head movements were tracked.

Results: Although blindside detection rates were higher for moving (73%) than static pedestrians (66%), [especially at 14 degrees eccentricities; 64% and 49%, respectively; p = 0.01], reaction times were longer for moving (2.2 s) than static pedestrians (1.5 s; p = 0.03), resulting in a similar proportion of untimely detections (30%). Seeing side detection rates were 100% and reaction times 1.1 s for both pedestrian types. As expected, detection of blindside pedestrians only occurred when head/eye scanning took gaze sufficiently far into the blind hemifield for the pedestrian to be fixated.

Conclusion: Even in a realistic hazard detection task with pedestrian figures on a collision course with participants, our findings suggest that drivers with hemianopia have significant blindside detection deficits.

Author Disclosure: None
Title: Visual Electrodiagnostic Testing after Head Injury: Usefulness and Limitations

Authors: Radouil Tzekov, Fiona Crawford

Affiliation: The Roskamp Institute, Sarasota, FL

Background: Visual electrodiagnostic testing using electroretinography (ERG) and visual evoked potentials (VEP) can provide objective information about the function of the visual system in various visual disorders, including traumatic optic neuropathy and retinal degeneration and dysfunction after head trauma.

Aim: To examine published studies of visual electrodiagnostic tests (ERG and VEP) with regard to their value in predicting the visual outcome from head injury.

Method: A comprehensive search of electronic databases (PubMed, Psych Info and Web of Science) was conducted using keywords for head trauma, ERG, VEP, etc.

Results: Only 4 studies were identified as using ERG: two using full-field stimulation, one using pattern stimulation and one using both. Application of standard full-field ERG protocol did not show any differences; however, the photopic negative response demonstrated decrease in amplitude which persisted after head trauma. Pattern ERG changes were also recorded and correlated with visual acuity. Furthermore, 22 studies involving more than 760 patients published between 1970 and 2002 using VEP were identified. Of those, nine studies used only flash VEP (fVEP), 11 studies used only pattern VEP (PVEP) and 2 studies used both flash and pattern stimulation. Only two studies (one using PVEP and one using fVEP) reported negative results. The majority of the studies found good correlation between unfavorable visual outcome and VEP parameters (amplitudes and timing of the peaks). The studies differed widely in methodology and none of the data were obtained after the introduction of the ISCEV standard for clinical visual evoked potentials (2004). Only one study was identified using multifocal VEP showing good predictive value in a limited number of patients.

Conclusion: Visual electrodiagnostic testing can be used to track the functional status of the visual system after head trauma. However, more work, using standardized tests and combining the results from several tests carries better promise in terms of diagnostic utility and predictive value.

Author Disclosure: no financial interest.
Poster #12

Title: Costs of Military Eye Injury, Vision Impairment, and Related Blindness and Vision Dysfunction Associated with TBI without Eye Injury

Authors: Kevin D. Frick

Affiliation: Johns Hopkins Bloomberg School of Public Health

Background: The cost of vision impairment from the combination of ocular injury in the military and traumatic brain injury in the military linked to visual dysfunction has not been estimated to date.

Aim: For the years 2000-2010, to estimate the cost of the combination of superficial eye injury, non-superficial eye injury that does not lead to permanent visual impairment, non-superficial eye injury that does lead to permanent visual impairment (that may or may not be bilateral blindness), and visual impairment related to traumatic brain injury. The costs include initial medical treatment, rehabilitation, support services, long-term excess medical care expenditures, and lost potential productivity.

Method: Epidemiological data on eye injury and resulting visual impairment, epidemiological data on traumatic brain injury and associated visual dysfunction, and data on the cost of treatment, rehabilitation, and productivity loss were obtained from the literature. These were combined systematically to estimate the short-run and long-run costs experienced by the military and by society at large.

Results: For the 11 years from 2000-2010 inclusive, the first year costs that were experienced for all injuries are estimated to be $634 million (including initial treatment and rehabilitation). The remaining lifetime VA benefits are estimated to be $188 million. The remaining societal costs are estimated to be $24.3 billion.

Conclusion: The annual incident lifetime cost of $2.3 billion is high and worthy of further research for prevention and rehabilitation to avoid as much of the future potential productivity loss and other costs as possible.

Author Disclosure: This work was supported by a grant from NAEVR.
Title: Ocular Battle Injuries Among U.S. Military Personnel, 2002-2011

Authors: LTC José Capo-Aponte¹, O.D., Ph.D., Leonard Temme¹, Ph.D., Michael Lo¹,², M.S.P.H., and Dan Wise¹,², M.Ed.

Affiliation: ¹United States Army Aeromedical Research Laboratory, Fort Rucker, AL ²Henry M. Jackson Foundation for the Advancement of Military Medicine, Inc.

Background: The incidence of ocular battle injuries (OBI) among U.S. military personnel as tabulated by the Joint Theater Trauma Registry (JTTR) is described.

Aim: This poster aims to raise awareness of the high incidence of OBI among U.S. military personnel and to drive research into the improvement of Warfighter personal protective equipment (PPE).

Method: Records of personnel who sustained an OBI from March 2002 through December 2011 were identified and abstracted from the JTTR. Frequencies and percentages of variable values describing OBI were tabulated. Eye injury severity was calculated using a scale of 1 to 4 adapted from Duma et al. (2002) and Thomas et al. (2009).

Results: A total of 1740 individual cases with OBI were identified. Blasts from improvised explosive devices (IEDs) caused 73 percent of cases. A total of 3245 OBI were identified, of which 50 percent were open wounds of the ocular adnexa and/or eyeball. Mean eye injury severity was 2.8. Approximately 67 percent of the OBI cases had another facial injury, 46 percent had a traumatic brain injury, and 21 percent had an auditory/vestibular injury. No data on PPE use were available.

Conclusion: Use of IEDs by enemy combatants was the predominant cause of OBI among U.S. military personnel. If available, data on PPE use would have enabled analysis of its effectiveness.

Author Disclosure: None.
Title: Ballistic Glass Debris Hazard Study

Authors: Matt Barsotti, Lawrence J. Nelson, Cliff Jones

Affiliation: Protection Engineering Consultants, LLC

Background: Ballistic resistant glazing is utilized for protecting personnel in a variety of applications, including building windows, vehicle windows, and protective transparent shields. When a bullet impacts the ballistic glazing and is successfully stopped, the glass layer on the protected side of the glazing layup can spall, creating a fragment hazard for protected personnel.

Aim: The Ballistic Glass Hazard Study (BGHS) was conducted to:
1. Gain an understanding of the spall characteristics of ballistic glazing layups,
2. Quantify the spall hazards to human occupants in terms of eye and skin injury risk, and
3. Assess different surrogate witness materials for standardized testing in the future.

Method: The injury testing utilized fresh-harvested porcine eyes and skin coupons as biological surrogates for human tissues. The eyes were pressurized to simulate correct intraocular pressure; the skin was placed on rounded foam backers to emulate the rounded cross-section of a limb or neck. The prepared specimens were then placed in the spall debris flyout area and impacted by glass shards. These specimens were examined post-test by an ophthalmological surgeon, who gauged injury levels and determined AIS injury scores. Various materials were evaluated to find a simple witness panel design and correlate it to a specific spall injury severity level. The panels were exposed to the same spalling debris, and the results were correlated to the eye injury data.

Results: An effective eye and skin test methodology was developed.
- The injury trends were fitted empirically, which allowed determination of overall injury likelihood.
- The witness panel design was shown to be correlated to the experimental eye injury levels.

Author Disclosure: None.
Title: Pathophysiological Damage in Ocular Tissues from Rats Exposed to Blast Overpressure

Authors: J-H. Choi 1,2, W. Greene1,2, M. Chavko4, J. Li3, J.J. Dalle Lucca3, H-C. Wang2

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Background: Blast-induced ocular injury is a frequent cause of morbidity for survivors of improvised explosive devices (IEDs). Blast overpressure of 120 ± 7 Kpa has been shown to cause damage to lungs, brain, and gut in a rat model, however, the effects of blast overpressure on ocular tissues have not been characterized. The pathophysiology of blast-induced ocular injury was examined by analysis of activated caspase 3 and expression of GFAP in ocular tissues from rats exposed to blast overpressure.

Aim: Characterize pathophysiological mechanisms of blast-induced damage to the eye in a rat model.

Method: A compressed air shock tube was used to deliver 120 ± 7 KPa blast overpressure of duration 2 ms to OD side of rats. Rats were euthanized at specific timepoints after blast exposure (3h, 24h, 48h). Ocular tissues were processed for immunohistochemistry to detect activated caspase 3 and GFAP. The number of positive cells was quantified.

Results: Activated caspase 3 (brown) was detected in the optic nerve, ganglion cells and inner nuclear layer post blast exposure. At 24 and 48 hours, the inner nuclear layer from the OD side had more cells with activated caspase 3 (Figure 1B). In the optic nerve, highest levels of activated caspase 3 were detected on the OD side at 24 hours post blast (Figure 1D). Light GFAP staining was confined to the nerve fiber layer and the ganglion layer.

Conclusion: Blast overpressure of 120 ± 7 Kpa induced optic neuropathy and retinal damage. In both optic nerve and retina, caspase 3 was activated following blast exposure. Activated caspase 3 was detected in both the OD and the OS sides. The results of this study reveal that blast exposure induces apoptosis in both the optic nerve and retinal tissues. Mild gliosis was also observed in the retina.

Figure 1

Author Disclosure: none
Poster #16

Title: Experimental blast-mediated TBI results in a biphasic loss of visual function.

Authors: Matthew Harper, Kabhilan Mohan, Helga Kecova, Elena Hernandez-Merino, Randy Kardon

Affiliation: Department of Veterans Affairs; The University of Iowa

Background: Blast mediated mild TBI is the leading cause of visual and neurological dysfunction in current military engagements. Understanding the time course of neuronal damage and dysfunction after exposure to a blast wave may help to guide rehabilitative therapies.

Aim: The aim of this study was to evaluate the acute and chronic effects of experimental blast-mediated TBI on the visual and central nervous system.

Method: The function and structure of the anterior afferent visual pathway was assessed using the pattern electroretinogram, the pupil light reflex and optical coherence tomography analysis. Central nervous system function was assessed using the rotarod assay.

Results: Using a novel blast wave injury model, our data revealed significant anterior afferent visual pathway and CNS damage. Assessment of the pupil response to light demonstrated a decreased maximum pupil constriction diameter in blast-injured mice using 24h after injury compared to baseline. A significant decrease in the pERG response was observed acutely following injury and returned to baseline values 24h after injury. A subsequent decline in the pERG response was observed by four months post injury and was sustained to one-year post injury compared to non-injured control mice. Furthermore, at three months following injury, a significant chronic nerve fiber layer deficit was observed in vivo compared to controls. Our structural and functional in vivo tests corresponded with pathological retina and optic nerve changes, including expression of oxidative stress-associated proteins.

Conclusion: Experimental blast mediated TBI results in Acute and chronic functional deficits with a transient recovery period. The recovery period may represent the best opportunity for rehabilitative treatment of visual deficits to prevent long-term damage.

Author Disclosure: None
**Title:** Sub-Lethal Ocular Trauma (SLOT): Establishing Standardized Blast Thresholds to Facilitate Diagnostic, Early Treatment, and Recovery Studies for Blast to the Eye and Optic Nerve

**Authors:** Walter Gray¹, Matthew Reilly¹, Brian Lund², Randolph Glickman³, William Sponsel, M.D.⁴

**Affiliation:** ¹University of Texas at San Antonio, ²U.S. Army Institute of Surgical Research (USAISR), ³University of Texas Health Science Center – San Antonio, ⁴Sponsel Professional Association

**Background:** A gap exists in our understanding of physical mechanisms and progression of blast-induced ocular trauma. The gap hampers our ability to design effective protective devices and may contribute to ineffective treatment and rehabilitation due to inadequate awareness of potentially vision-threatening injury. As have been demonstrated in a previous study (Sponsel et al., IOVS, v. 52, 2011), significant internal injury can occur to the eye at very low levels of insult energy.

**Aim:** Address the knowledge gap by experimentally and computationally identifying sub-lethal (sub-globe rupture) injury mechanisms and their progression with increasing blast energy and impulse. Identify and assess potential biomarkers associated with each injury mechanism.

**Method:** Using the USAISR large shock tube, we will identify and characterize a full range of potential injury mechanisms from mild angle recession to globe rupture using first *ex vivo* porcine eyes, then *in vivo* rabbit eyes. Our goal is to correlate a range of injury types and mechanisms with peak blast pressure and impulse. The experimental program will be supported with a biochemical marker study and an extensive series of numerical simulations using physics-based computer codes CTH and LS-DYNA. The computer simulations will allow for a more complete characterization of the physics of tissue response, and ultimately the design of more effective eye protection.

**Results:**

**Conclusion:**

**Author Disclosure:** The authors have are no financial or conflicts of interest with the proposed program. Note this poster is submitted at the request of Robert Reed (TATRC) and Darlene Dartt to advertise a recently awarded Vision Research Program (VRP) grant. The program is not scheduled to begin until fall 2012, thus no results or conclusions can be reported.
Poster #18  
Title: Inhibition of experimental PVR with the tyrosine kinase inhibitor Dasatinib

Authors: K. Umazume, LanHsin Liu, Patrick Scott, Juan Fernandez de Castro, Kevin McDonald, H. Kaplan, S. Tamiya

Affiliation: Department of Ophthalmology and Visual Sciences, University of Louisville

Background: Proliferative vitreoretinopathy (PVR), a scar formation on the surface of the retina, is the major complication following ocular eye injury. Prevention of PVR is critical since corrective surgery for PVR does not have high success rate in restoring visual function.

Aim: To test the efficacy of dasatinib, a FDA-approved tyrosine kinase inhibitor, to prevent PVR.

Method: The effect of dasatinib on retinal pigment epithelial (RPE) cell proliferation, migration, and contraction was assessed in vitro. Our swine model of experimental PVR was used to assess the efficacy of dasatinib in preventing traction retinal detachment (TRD) caused by PVR. Full-field electroretinography and histological examination were used to determine the retinal toxicity of dasatinib.

Results: Dasatinib prevented RPE cell migration, proliferation, and collagen gel contraction in vitro in a dose-dependent manner. Dasatinib also prevented TRD caused by PVR in vivo. Dasatinib did not cause any detectable toxicity of the retina.

Conclusion: Dasatinib significantly inhibited PVR-related RPE changes in vitro and prevented TRD in an experimental PVR model in the swine without any detectable toxicity. Our data suggest that Dasatinib may be effective in the prevention of PVR.

Author Disclosure: No financial conflict of interest. Supported by DOD grant DM090475.
Title: Ranibizumab is a potential prophylaxis for proliferative vitreoretinopathy, a non-angiogenic blinding disease

Authors: Steven Pennock¹, Ph.D., David Kim¹, M.D., Shizuo Mukai¹, M.D., Matthew Kuhnle², M.D., Dal W. Chun², M.D., Joanne A. Matsubara³, Ph.D., Jing Cui³, Ph.D., Patrick Ma³, M.D., David Maberley³, M.D., Arif Samad⁴, M.D., R.J. van Geest⁵, M.D., Sarit Lesnik Oberstein⁵, M.D. Ph.D., R.O. Schlingemann⁵, M.D. Ph.D., Andrius Kazlauskas¹*, Ph.D.

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Background: Proliferative vitreoretinopathy (PVR) is an example of a disease that is difficult to predict, lacks effective treatment options, and substantially reduces an individual's quality of life. It is the primary reason that surgery to correct rhegmatogenous retinal detachment fails. Likely mediators of PVR are growth factors in vitreous, which stimulate cells within and behind the retina as an inevitable consequence of a breached retina. Three classes of growth factors - vascular endothelial growth factor A [VEGF-A], platelet-derived growth factors [PDGFs] and non-PDGFs (growth factors outside the PDGF family) - are relevant to PVR pathogenesis because they act upon PDGF receptor alpha (PDGFRα), which is required for experimental PVR, and is associated with this disease in humans.

Aim: We sought to determine whether ranibizumab (RBZ), an anti-VEGF-A monoclonal antibody fragment, could reduce the pathogenic bioactivity of vitreous from patients and experimental animals with PVR, and whether it could protect rabbits from developing this disease.

Method: The bioactivity of vitreous from animals and patients with PVR was assessed using biochemical outcomes and responses (contraction, survival) of cultured cells. Experimental PVR was induced by injecting fibroblasts into vitreous of rabbits.

Results: RBZ, one of the clinically approved agents that neutralizes VEGF-A, reduced the bioactivity of vitreous from patients and experimental animals with PVR, and protected rabbits from developing disease. The mechanism of action of RBZ involved de-repressing PDGFs, which at the concentrations present in PVR vitreous, inhibited non-PDGF-mediated activation of PDGFRα. Moreover, the ratio of VEGF-A/PDGF correlated with clinical PVR.

Conclusion: These pre-clinical findings suggest that currently available approaches to neutralize VEGF-A are prophylactic for PVR, and that anti-VEGF-based therapies may be effective for managing more than angiogenesis- and edema-driven pathological conditions.

Author Disclosure: none
Title: Optic nerve regeneration in adult mice: reinnervation of central visual nuclei and partial recovery of visual responses

Authors: S. de Lima, Y. Koriyama, T. Kurimoto, J. T. Oliveira, Y. Yin, Y. Li, H.Y. Gilbert, M. Fagiolini, A.M. Blanco Martinez, and L. I. Benowitz

Affiliation: Children’s Hospital/Harvard Med. School, Federal Univ., Rio de Janeiro

Background: Retinal ganglion cells (RGCs) normally cannot regenerate their axons, leaving victims of traumatic nerve injury or degenerative diseases such as glaucoma with lifelong visual losses. Recent studies have identified molecular pathways that allow for partial regeneration, but visual recovery remains elusive.

Aim: It is currently unknown whether regenerating retinal axons can enter the brain in large numbers, navigate to correct target sites, and most importantly, restore vision.

Method: We combined three manipulations that synergistically enhance regeneration: a limited inflammatory response in the eye to elevate levels of oncomodulin and other growth factors; elevation of cAMP; and deletion of the pten gene to derepress signaling through the PI3 kinase pathway. Regeneration was examined anatomically at the light and EM levels; functional recovery was evaluated with a battery of visual tests.

Results: The 3-way treatment enabled RGCs to regenerate damaged axons along the entire length of the optic nerve, across the optic chiasm, and into the optic tract, selectively innervating the suprachiasmatic nucleus, dorsal lateral geniculate nucleus, superior colliculus, and other visual areas. EM through the optic nerve revealed varying degrees of myelination. Immunostaining for pre- and postsynaptic markers indicated that axons formed synapses in target areas. Regeneration partially restored the optomotor response, depth avoidance; and circadian photoentrainment.

Conclusion: These studies demonstrate the feasibility of restoring central visual projections and restoring simple visual functions after optic nerve injury in a mature mammalian model.

Author Disclosure: none
Title: Proto-oncogene Receptor c-Met Modulates RPE Responses to Laser-Induced Retinal Injury

Authors: Jie Ma¹, Masataka Kasaoka¹.², Kameran Lashkari¹

Affiliation: ¹ Schepens Eye Research Institute, Massachusetts Eye & Ear Infirmary, Department of Ophthalmology, Harvard Medical School, Boston, MA. ² Kurume University, School of Medicine, Department of Ophthalmology, Kurume, Japan

Background: Retinal laser injuries are often associated with aberrant migration of the retinal pigment epithelium (RPE) resulting in expansion of the scar beyond the confines of the original laser burn and long-term visual outcome. Control of RPE migration may have therapeutic utility in controlling laser-induced scar expansion.

Aim: It is known that the proto-oncogene receptor c-Met participates in RPE cell migration and transdifferentiation. We assessed whether retinal laser injury activated c-Met through release of its ligand, HGF, and whether augmentation or abrogation of c-Met activity could influence laser-induced RPE cell migration.

Method: We devised a novel method of laser-induced injury to the RPE layer in transgenic mice harboring the wild-type, constitutively active or abrogated c-Met receptor and began to dissect the mechanisms associated with pathogenesis and progression of laser-induced RPE injury. RT-qPCR and immunohistochemical staining were also applied to quantify the gene and protein expressions in laser-induced murine eyes.

Results: In response to laser-induced injury, c-Met, p-Met and HGF were detected in RPE layer and RPE cells had migrated to outer retinal layers. Constitutive activation of c-Met induced more robust RPE migration into the outer retina, while abrogation of the receptor using a cre-lox method reduced these responses. In addition, retinal laser injury increased expression of both HGF and c-Met, and activation of c-Met after injury directly correlated with RPE cell migration.

Conclusion: In response to retinal laser injury, c-Met receptor system is activated through release of HGF and is intimately involved in RPE responses of to laser injury. This is supported by the observation that constitutive activation of c-Met increased RPE migration while abrogation of the receptor diminished RPE cell migration into the retina. Our studies strongly suggest that control of c-Met activity may be a future therapeutic target to minimize retinal damage that may ensue after laser injury.

Author Disclosure: The authors have declared that no competing interests exist. The study was supported by a grant (W81XWH-04-1-0892-P00001) from the Department of Defense.
Title: Characterization of Sodium Iodate-induced retinal degeneration

Authors: Jinmei Wang, Magali Saint-Geniez.

Affiliation: Schepens Eye Research Institute, Massachusetts Eye and Ear Infirmary, Department of Ophthalmology, Harvard Medical School, Boston.

Background: Sodium Iodate (NaIO3) injection leads to regional retinal pigment epithelium (RPE) death identical to dry AMD. While this model is commonly used for the evaluation of new therapies for ocular diseases such as AMD, there is limited information on NaIO3-dependent ocular changes. Characterization of dose and time-dependent effects of NaIO3 is critical to assess the potential of new translational therapies such as stem-cell transplantation.

Aim: To systemically characterize the effects of NaIO3 on retinal morphology and function.

Method: 10, 20 or 30 mg/kg NaIO3 and saline solution was administered by retro-orbital injection to adult C57BL/6 mice. Phenotypic changes of the outer retina were assessed at 1, 3, 5 and 8 days post injection by fundus imaging, optical coherence tomography (OCT), and H&E staining. Flat-mounted outer-retinas were immunostained for RPE65 and F-actin. Longitudinal study of visual behavior was performed by electroretinography (ERG).

Results: Fundus changes were observed from day 3 for NaIO3 doses of 20 and 30 mg/kg. Histological evaluation confirmed regional RPE dystrophy as early as day 1 followed by progressive RPE loss. Few morphological changes were observed in the 10mg/kg group, however immunohistological analysis revealed decreased RPE65 expression at day 8. Retinal function was normal in the 10mg/kg group, but higher concentrations induced a dramatic decrease of the b- (50%) and a-waves (30%) at day 1, followed by complete loss of the b-wave at day 3. Significant outer nuclear layer thinning measured by OCT and histology was also observed.

Conclusion: Systematic characterization of retinal changes associated with NaIO3 injection revealed a large variability in the severity of the retinal toxicity induced. Treatments inducing RPE loss were also associated with rapid ERG changes suggesting direct photoreceptor toxicity. The lower dose tested preserved retinal morphology while reducing expression of the visual cycle protein RPE65 and therefore be more appropriate for pre-clinical evaluation of new AMD therapies.

Author Disclosure: None
Poster #23

Title: A Tissue Engineering Scaffold for Epithelial Tissue Regeneration

Authors: Kevin J. McHugh¹-³, Sarah L. Tao³-⁴, Magali Saint-Geniez¹,⁵

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Background: Tissue engineering has the potential to revolutionize medicine by providing tissues and organs to replace function lost due to damage or disease. However, cells alone are often insufficient to achieve proper tissue structure, thus a supporting scaffold may be required. In recent years, porous scaffolds have gained popularity for their ability to support gas and nutrient exchange, a requirement for all tissues and of particular importance for epithelium. Despite this fact, current scaffolds are poorly suited for two-dimensional tissues such as retinal pigment epithelium, endothelium, and large organ epithelium due to unavoidable consequences of the scaffold fabrication methods available today.

Aim: This study develops a novel fabrication technique that produces scaffolds that are uniform, non-tortuous, and reproducible at the sub-micron scale without inducing potentially deleterious topography.

Method: A two-step process was used to fabricate porous polymeric scaffolds. First, a silicon mold with high aspect ratio, sub-micron cylinders was produced using photolithography and deep reactive ion etching. A polycaprolactone (PCL) solution was then cast onto the microfabricated mold using spin-assisted templating to create a thin film scaffold with pores formed by the cylinders on the mold. Multiple epithelial cell types including RPE and endothelium were cultured on the porous PCL scaffolds and compared to cells cultured on electrospun (porous) or non-porous PCL.

Results: This fabrication technique resulted in fully-deterministic porous PCL films. Pores were 650 ± 120nm in diameter and fully penetrated the 10µm thick scaffold. All cell types cultured on porous PCL achieved superior behavior compared to control materials as assessed using adherence, viability, transepithelial resistance, and immunohistochemistry.

Conclusion: The process described herein is capable of producing fully-deterministic porous scaffolds. Results from this study suggest that these scaffolds may enhance cell behavior and therefore merit further investigation for engineering epithelium, the tissue type most ready to be translated to the clinic.
Poster #24

Title: A Novel Function of p53: A Gatekeeper of Retinal Detachment

Authors: Hetian Lei¹²³, Marc-Andre Rheaume²³, Jing Cui⁴, Shizuo Mukai²³, David Maberley⁴, Arif Samad⁵, Joanne Matsubara⁴, and Andrius Kazlauskas¹²³

Affiliation: The Schepens Eye Research Institute¹, Massachusetts Eye and Ear Infirmary², Department of Ophthalmology, Harvard Medical School³, Ophthalmology and Visual Sciences, University of British Columbia⁴, Dalhousie University⁵, Canada.

Background: Proliferative vitreoretinopathy (PVR) is a blinding disease that afflicts 5-11% of patients that undergo surgery to correct a rhegmatogenous retinal detachment. The current treatment for PVR is repeat surgery. Thus there is an acute need for pharmacological treatment of this disease.

Aim: The goals of this study were to 1) test if the previously noted correlation between the platelet-derived growth factor receptor α (PDGFRα)-mediated decline in the level of p53 and development of PVR was causally related, and 2) test if Nutlin-3-mediated stabilization of p53 is effective in inhibiting PVR progression to retinal detachment (RD).

Method: The goals of this study were to 1) test if the previously noted correlation between the platelet-derived growth factor receptor α (PDGFRα)-mediated decline in the level of p53 and development of PVR was causally related, and 2) test if Nutlin-3-mediated stabilization of p53 is effective in inhibiting PVR progression to retinal detachment (RD).

Results: Suppression of p53 expression was required for PDGFRα-mediated contraction of cells in a collagen gel, and for RD in the rabbit model of PVR. Furthermore, maintenance of p53 expression with Nutlin-3 protected rabbits from RD. In addition, Nutlin-3 prevented human PVR vitreous-induced contraction of cells isolated from a patient PVR membrane.

Conclusion: p53 appears to be a gatekeeper of RD in PVR. Nutlin-3, which enforces p53 expression, may be effective in suppressing RD in patients afflicted by PVR.

Author Disclosure: No financial conflict of interest.
Title: The transcriptional co-factor PGC-1 alpha is upregulated in response to oxidative stress in photoreceptors.

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Affiliation: 1- Schepens Eye Research Institute, Massachusetts Eye and Ear Infirmary, Department of Ophthalmology, Harvard Medical School. 2- Cardiovascular Institute, Beth Israel Deaconess Medical Center, Harvard Medical School

Background: The retina, and photoreceptors in particular, are especially sensitive to oxidative stress due to their high oxygen consumption, high levels of irradiation (by light), and abundance of readily oxidized poly-unsaturated fatty acids in photoreceptor outer segments. Oxidative stress is thought to significantly contribute to the pathogenesis of numerous retinal diseases, including age-related macular degeneration (AMD) and retinitis pigmentosa (RP). The transcriptional co-activators, peroxisome proliferator-activated receptor-gamma coactivator 1 alpha and beta (PGC-1a/b) are known to play a role in defending cells against oxidative stress by increasing expression of a number of anti-oxidant enzymes including superoxide dismutase and catalase.

Aim: To examine the expression of PGC-1a/b in the retina and their role in the oxidative stress response in photoreceptors in vitro.

Method: Expression of PGC-1a/b in mouse retina was studied by in situ hybridization and qPCR. 661w, cone photoreceptor-like cells, were exposed to H₂O₂ or bright light. Oxidative stress and reactive oxygen species (ROS) were measured by CM-H₂DCFDA fluorescence. Cell death was analyzed by LDH release. RNA was extracted from cells using RNA-bee reagent. PGC-1a/b and selected anti-oxidant enzyme gene expression was analyzed by qPCR.

Results: PGC-1a and b expression increased 52 and 311 fold, respectively, during post-natal retinal development in mice, coinciding with increased mitochondrial gene expression. PGC-1a was significantly (p<0.01) up-regulated in response to 250 mM H₂O₂ exposure for 2 hours. Bright light exposure for 12, 15, and 18 hours significantly up-regulated PGC-1a expression and significantly increased ROS (p<0.05) and cell death (p<0.01) at 18 hours compared to control.

Conclusion: Increasing PGC-1a/b expression suggests a role in regulating the mitochondria burst associated with photoreceptor post-natal development. The oxidative stress induced increase in PGC-1a expression implies a role in the anti-oxidant response in 661w. Future studies will determine if knock-down or over-expression of PGC-1a can alter the susceptibility of photoreceptors to oxidative stress.

Author Disclosure: None
Title: IGF-1 Binding Protein Like Protein 1 (IGFBPL-1) Promotes Axon Outgrowth In Retinal Ganglion Cells Through The Regulation Of IGF-1 Signaling Pathway

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Background: IGF-I has been implicated to play an important role in neuronal cell survival and axonal growth, however the underlying mechanisms remain unclear. We recently found that a newly discovered protein, IGFBPL-1, regulates the growth of retinal ganglion cell (RGC) axons.

Aim: To elucidate the functional significance and underlying mechanisms of IGFBPL-1 in mediating RGC survival and axon extension.

Method: The expression of IGFBPL-1 in the developing retina was examined using immunohistochemistry, western blot and qRT-PCR. To study the function and underlying signaling of IGFBPL-1, RGCs were purified from mouse pups and cultured in the presence or absence of IGFBPL-1 and/or IGF-I proteins. RGC survival and axonal growth were evaluated using LIVE/DEAD® and β-III-tubulin immunostaining. Knockdowns of IGF-I and IGFBPL-1 signaling were achieved by lentiviral shRNAs or application of inhibitors of IGF-I downstream pathways. Recombinant IGFBPL-1 and/or IGF-I proteins were injected intravitreally into adult C57BL/6 mice post-optic nerve crush to study their effects in vivo. Axonal regeneration following optic nerve crush were quantitatively assessed by labeling RGC axons with cholera toxin B subunit (CTB). The number of CTB+ axons extended posterior to the crush site was recorded.

Results: IGFBPL-1 was highly expressed in RGCs at E16 but was largely down-regulated postnatally. Addition of IGFBPL-1 alone or together with IGF-I to P0 and P10 RGC cultures significantly promoted axonal extension. Blockade of IGF-I signaling eliminated IGFBPL-1-mediated axonal growth effect. Moreover, intravitreal delivery of IGFBPL-1 significantly promoted optic nerve regeneration following optic nerve injury in adult mice.

Conclusion: IGFBPL-1 is an important regulator of RGC axonal growth during retinal development, likely functioning through the IGF-I signaling pathways. These studies provide new avenues to uncover the molecular events regulating RGC axon growth, which will lead to potential therapeutic strategies for optic nerve protection and eventually regeneration or repair.

Author Disclosure: All authors have no financial disclosure and conflict of interest.
Title: Human retinal progenitor cells for photoreceptor replacement

Authors: Petr Baranov, CaiHui Jiang, Ruilin Wang, Michael Young

Affiliation: Schepens Eye Research Institute, Massachusetts Eye and Ear, an affiliate of Harvard Medical School

Background: Both penetrating and non-penetrating ocular injuries, arising from exposure to blast forces, may be associated with retinal damage and photoreceptor loss resulting in severe visual deterioration. Replacement of photoreceptors has been suggested as a potential therapeutic approach for the treatment of retinal cell loss due to trauma or degeneration. Previously we have shown that human retinal progenitor cells (hRPC), isolated from human fetal retina are able to form mature retinal cell types, including photoreceptors, \textit{in vitro}.

Aim: To investigate the ability of hRPCs to survive and form photoreceptors after transplantation into the subretinal space of rhodopsin knockout mice

Method: Human retinal progenitor cells (hRPC) were isolated from 16 week gestational age retina and expanded \textit{in vitro} under GMP conditions up to passage 9. Cells were characterized by flow cytometry to express progenitor markers (Sox2, Pax6, Otx2, Nestin, Vimentin, CD73, PSA-NCAM, SSEA4). 50,000 cells, pre-labeled with Pkh26 (Sigma), were transplanted into subretinal space of rhodopsin-knockout mice in 1ul of HBSS. The mice were under an immunosuppressive regimen (Cyclosporine A 210 mg/L in drinking water) for the duration of the study.

Results: Human retinal progenitor cells survived in the subretinal space of rhodopsin knockout mice and migrated into ONL, INL and GCL 3 weeks after transplantation as shown by OCT and histology (Pkh26 and MTC02) analysis. CD45 staining revealed moderate infiltration of the transplant with host leukocytes, but we have not observed any leukocytes in the retina, as was seen in non-immunosuppressed animals. We observed the characteristic morphology of rods with proper integration and outer segment formation.

Conclusion: Human retinal progenitor cells survive after transplantation into a degenerated host, integrate into host retina and differentiate toward photoreceptors. These results suggest that hRPCs have potential for photoreceptor replacement therapy.
Title: The critical role of endomucin-1 in leukocyte-endothelial cell interaction

Authors: Jinling Yang¹, ², Alisar Zahr¹, ², Pilar Alcaide³, Alexander Jones¹, Meredith Gregory-Ksander¹, ², Pablo Argueso¹, ², Bruce Ksander¹, ², Patricia A. D’Amore¹, ²

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Background: Leukocyte-endothelial cell (EC) interaction is a central event during vascular inflammation, including leukocyte rolling, adhesion and transmigration. Endomucin-1, a transmembrane glycoprotein specifically expressed in venous and capillary endothelium, has been shown to have anti-adhesive property.

Aim: This study is aimed at determining the role of endomucin-1 in leukocyte-EC interaction under inflammatory conditions.

Method: In an in vitro study, human umbilical vein endothelial cells (HUVECs) were treated with TNFα (0.1 - 25 ng/ml, 24 hrs), a prominent inflammatory cytokine. Cell surface and total endomucin-1 protein was analyzed by biotinylation and western blot. Endomucin-1 mRNA was measured by quantitative real-time PCR. HUVECs were transduced with Ad-EMCN-1 to overexpress endomucin-1 or Ad-GFP as control and then treated with TNFα. Flow adhesion assay was performed to analyze leukocyte-EC interaction in vitro. For analysis in vivo, C57/B6 mice were intravitreally injected with TNFα 10ng/µl or saline. Ciliary bodies, where prominent leukocyte infiltration takes place, were harvested 48 hrs later to analyze endomucin-1 protein by western blot or to identify infiltrating inflammatory cells by flow cytometry using CD45 as a marker.

Results: TNFα led to a dramatic reduction of endomucin-1 in cell surface protein, total protein and mRNA levels and to an increase in leukocyte-EC interaction. Adenovirus-mediated overexpression of endomucin-1 in HUVECs significantly reduced TNFα-induced leukocyte-EC interaction. In vivo, TNFα led to a reduction in endomucin-1 protein and to an increase in CD45+ cells, which was blocked by overexpression of endomucin-1.

Conclusion: Downregulation of endomucin-1 under inflammatory conditions facilitates leukocyte-EC interaction in vitro and in vivo. Overexpression of endomucin-1 in vitro strongly reduces leukocyte adhesion in TNFα-activated endothelium. These results suggest a critical role for endomucin-1 in maintaining the endothelium in a quiescent state as well as in facilitating leukocyte-EC interaction during inflammation.

Author Disclosure: None
Title: Mesenchymal Stem Cells Suppress Alloimmunity in Corneal Transplantation

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Background: Bone marrow-derived mesenchymal stem cells (MSC) display a unique anti-inflammatory and immunomodulatory property, and have the potential for treating various immune diseases.

Aim: To investigate the capacity of mesenchymal stem cells (MSC) to suppress induction of alloimmune responses in corneal transplantation.

Method: MSC were generated from the bone marrow of GFP-C57BL/6 mice. Corneal grafts from BALB/c (H-2d) mice were transplanted onto C57BL/6 (H-2b) recipient mice. Phenotypically (expression of CD45⁻CD34⁻SCA1+CD29⁺) and functionally (differentiation into adipocytes) characterized MSC (1x10⁶ cells) were intravenously administered to one group of allograft recipients after 2h of transplant surgery. Homing of administered MSC to the corneas was examined at day 3 post-transplantation by immunohistochemistry. Frequencies of IFNγ⁺ T cells in the draining lymph nodes (LN) were analyzed at day 14 post-transplantation using the ELISPOT assay. Frequencies of mature CD11C⁺MHC-II⁺ antigen-presenting cells (APC) in the corneas and draining LN were analyzed by flow cytometry.

Results: Intravenously injected MSC were found in the transplanted cornea, but not in the normal (contralateral) cornea. The draining LN of MSC-injected allograft recipients showed significantly lower frequencies of the both directly (316±10 vs. 350±17 T cells, p=0.023) and indirectly (42±6 vs. 69±15 T cells, p=0.03) allosensitized IFNγ-secreting T cells compared to the control group. The frequencies of mature CD11C⁺MHC-II⁺ APC were substantially decreased in the corneas (50.2% vs. 76.7%) and draining lymph nodes (4.4% vs. 8.4%) of MSC-injected allograft recipients compared to control group.

Conclusion: Our data demonstrating MSC homing to transplanted corneas, suppression of APC maturation, and inhibition of induction of alloreactive T cells suggest that MSC display immunomodulatory properties which could be used to prolong allograft survival.

Author Disclosure: The authors have nothing to disclose.
Poster #30

Title: Potential therapies for vesicant-inflicted ocular injuries

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Background: There are no effective and safe therapies against devastating ocular injuries by vesicating chemical agents sulfur mustard (SM), nitrogen mustard (NM) and lewisite (LEW).

Aim: Establish accessible ocular injury model suitable for laboratory studies by NM and identify effective and safe therapies against vesicant-induced ocular injuries.

Method: Biomarker studies were carried out in excised rabbit corneas exposed to 100 nmol NM for 2 h, and then washed and cultured for 24 h. For efficacy studies, rabbit corneas were untreated or treated with agents 2 h and every 4 h thereafter, for 24 h following NM exposure. The agents employed were approved prescription drugs dexamethasone (DM, 0.1% - anti-inflammatory steroid) and doxycycline (DC, 100 nmol-antibiotic and MMP inhibitor), and silibinin (SB, 100 µg, natural flavanone) found to be effective in treating vesicant-induced skin injuries in our earlier studies.

Results: NM exposure caused increases in epithelial thickness, ulceration and necrosis, apoptotic cell death, epithelial detachment and microbullae formation, levels of angiogenic regulator VEGF, and induction of COX-2 and MMP-9. Treatments of DC + DM, and SB were more effective than DC or DM alone in the reduction of NM-induced epithelial thickness, microbullae formation, apoptotic cell death, and MMP-9 levels. However, DM and SB, and all three agents alone were more effective in reversing NM-induced VEGF, and COX-2 levels, respectively.

Conclusion: Apart from DC and DM, these results show therapeutic strong efficacy of silibinin in reversing NM-induced ocular injuries, which could help develop effective and safe therapeutics against ocular injuries by vesicants.

Acknowledgement: This work was supported by supplemental grant from the Department of Pharmaceutical Sciences, University of Colorado Denver.
Title: Corneal endothelial dysfunction in acute and chronic corneal sulfur mustard injuries: are we patching the roof while the basement is flooding?

Authors: Patrick McNutt, Megan Lyman, Kaylie Tuznik, Angie Adkins, Marian Nelson and Tracey Hamilton

Affiliation: US Army Medical Research Institute of Chemical Defense, APG-EA, MD 21010.

Background: Sulfur mustard (SM) is a reactive alkylation agent that is a highly effective chemical warfare vesicant. Although the acute corneal lesions resulting from ocular SM exposure often resolve clinically, mustard gas keratopathy (MGK) develops in 16% of those that receive a moderate dose, involving corneal sequelae such as persistent edema, recurring epithelial lesions, neovascularization and progressive degeneration. The etiology of MGK is unknown, and therapies targeting the anterior cornea have not been effective.

Aim: A persistent corneal edema 2 wk after exposure is predictive of MGK. Current findings suggest that fluid transfer at lateral and anterior corneal boundaries does not substantively contribute to persistent edema (McNutt et al., Cornea 2012; McNutt et al., PLoS One, 2012). Here we evaluate longitudinal changes in the posterior of vapor-exposed corneas to evaluate a potential role for corneal endothelial dysfunction in the development of MGK.

Method: Rabbits were exposed to SM using a corneal vapor cup delivery model (Milhorn et al., NYAS, 2010). Corneas were evaluated from 1 d to 8 wk using clinical evaluations, in vivo confocal microscopy (IVCM), transmission electron microscopy (TEM) and scanning electron microscopy (SEM).

Results: SM exposure caused corneal endothelial cell (CEC) loss within 24 h. The integrity of the corneal endothelium continued to degenerate through 8 wk, as imaged by SEM and TEM. Initial IVCM analysis at 2 wk confirmed these findings, demonstrating abnormalities in CEC shape and size, including a 35% decrease in CEC density.

Conclusion: Unlike corneal epithelial cell disorders, the temporal appearance of corneal endothelial dysfunction is consistent with a causative role in the etiology of MGK. CEC toxicity also offers a mechanism consistent with the clinically asymptomatic period that often appears prior to the appearance of MGK. These findings have significant implications for clinical evaluation and management of ocular SM casualties.

Author Disclosure: This research was supported by the Defense Threat Reduction Agency – Joint Science and Technology Office, Medical S&T Division. The views expressed in this abstract are those of the authors and do not reflect the official policy of the Department of Army, Department of Defense, or the U.S. Government. The experimental protocol was approved by the Animal Care and Use Committee at the United States Army Medical Research Institute of Chemical Defense and all procedures were conducted in accordance with the principles stated in the Guide for the Care and Use of Laboratory Animals and the Animal Welfare Act of 1966 (P.L. 89-544), as amended.
Title: Cornea Protection for Burn Patients

Authors: I.E. Kochevar, E. Verter, T. Gisel, A.J. Johnson

Affiliations: Wellman Center for Photomedicine, Massachusetts General Hospital, Harvard Medical School and US Army Institute for Surgical Research

Background: Burn patients with severe, contracted peri-orbital scar are unable to blink, a condition called ectropion that often results in epithelial defects, corneal erosion and potentially opacification. Amniotic membrane (AM) provides a healing environment for damaged cornea but is rapidly degraded by proteolytic enzymes in tears of ectropion eyes. We hypothesized that crosslinking proteins in AM would produce a degradation resistant protective material for cornea.

Aim: To modify AM to produce a protective covering for cornea of burn patients that is resistant to proteolytic degradation.

Methods: Proteins in AM were crosslinked with chemical and physical methods. Bacterial collagenase was used to test enzymatic degradation, which was quantitated with a fluorescence-based assay. The influence of crosslinking methods on TGF-β and EGF in AM was measured by ELISA. The stiffness of the modified AM was measured by uniaxial tensiometry. The bonding of modified AM to cornea was tested in ex vivo.

Results: Proteolytic degradation decreased after all crosslinking methods. Protection decreased in the order: glutaraldehyde = carbodiimide = genipin > Rose Bengal photosensitization > germicidal UVC > riboflavin photosensitization. TGF-β and EGF were significantly reduced by crosslinking. AM stiffness was increased by crosslinking but the modified AM remained sufficiently flexible for use as monolayers. Tri-layer crosslinked AM became too stiff for use. Crosslinking with carbodiimide and genipin produced modified AM with the best combination of resistance to enzymatic degradation, ability to bond to cornea and low stiffness.

Conclusion: Proteolysis-resistant crosslinked AM may be a suitable material for covering and protecting inflamed cornea of burn patients. Evaluation of this material in an animal model for ectropion is warranted.

Author Disclosure: IEK is a consultant for AuraMedsystems, which has licensed the photo-crosslinking technology.
Title: Inhibitory Role of D-Series Resolvins in the Cellular Response to the TrpV1 Pain Channel in Trigeminal Ganglion Neurons

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Background: Resolvins (Rv) are lipids that are responsible for the active resolution of inflammation. Recent studies have suggested that the resolvins are capable of inhibiting pain associated with inflammation.

Aim: Our goal was to determine the effects of RvD1, aspirin triggered (AT)-RvD1, and RvD2 on the intracellular calcium concentration ([Ca\(^{2+}\)]\(_i\)) response to the TRPV1 pain receptor agonist, capsaicin, in cultured trigeminal ganglion neurons.

Method: Neuronal cells of the rat trigeminal ganglia were isolated and cultured on 35 mm glass bottom dishes that had been treated with poly-D lysine and laminin. Cells were incubated in the presence or absence of RvD1, RvD2, or AT-RvD1. Cells were then loaded with Fura-2 to detect changes in [Ca\(^{2+}\)]\(_i\). [Ca\(^{2+}\)]\(_i\) was measured in response to capsaicin.

Results: RvD1, AT-RvD1, and RvD2 significantly inhibited the increase in [Ca\(^{2+}\)]\(_i\) in response to capsaicin. In addition the localization of lipoxin A4 (ALX) receptor that can be used by RvD1 and AT-RvD1 and nestin that indicates neurons was detected in the plated cells using immunofluorescence microscopy.

Conclusion: The ability of D-series resolvins to inhibit the Ca\(^{2+}\) response to capsaicin suggests that this type of resolvin has the potential to be an effective endogenous analgesic in pain conditions of the face and head.

Author Disclosure: Supported by Department of Defense Grant W81XWH-09-2-0091.
Title: Inflammatory Cytokines In Thrombospondin-1 Deficient Conjunctiva Block Goblet Cell Mucin Secretion

Authors: Laura Contreras-Ruiz, Arpita Gosh-Mitra, Bruce Turpie, Marie Shatos, Darlene A. Dartt, Sharmila Masli.

Affiliation: Schepens Eye Research Inst and Massachusetts Eye and Ear, Department of Ophthalmology, Harvard Medical School, Boston, MA.

Background: Ocular surface inflammation in thrombospondin-1 (TSP-1) deficient mice is associated with autoimmune Sjögren’s syndrome.

Aim: To determine if the cytokines presented in TSP-1 null inflamed conjunctiva alter mucin secretion from mouse conjunctiva goblet cells (GC).

Method: Conjunctival tissues and pilocarpine-stimulated tears were collected from WT (C57BL/6) and TSP-1 null mice at 6, 8 and 12 weeks of age. Cytokines (IFN-γ, TNF-α, IL-6 and IL-17) and MUC5AC expression was quantified by RT-PCR and tear MUC5AC was determined by ELISA. Primary cultures of mouse conjunctival GCs were grown from WT conjunctival explants. GC specific (CK-7 and MUC5AC) and stratified squamous cell specific (CK-4) marker expression was evaluated by immunofluorescence and flow cytometry (MUC5AC). Cultured GCs were treated with IFN-γ, TNF-α, IL-6 and IL-17, followed by stimulated with the cholinergic agonist carbachol. Secretion of MUC5AC in the supernatant was assessed by ELISA.

Results: Expression of inflammatory cytokines IFN-γ, TNF-α, IL-6 and IL-17 was significantly increased in TSP-1 null conjunctiva compared to age matched WT controls, while MUC5AC expression was significantly reduced compared to WT controls. Consistent with these results, tear MUC5AC levels were also significantly lower in TSP-1 null mice compared to WT. Almost all conjunctiva tissue derived cultured cells expressed GC specific markers CK-7 and MUC5AC, but were negative for the squamous cell marker CK-4. Treatment of cultured GC with IFN-γ and TNF-α significantly inhibited, while IL-6 treatment enhanced carbachol-mediated secretion of MUC5AC. GC treated with IL-17 did not alter their carbachol-mediated MUC5AC secretion.

Conclusion: The pro-inflammatory cytokines expressed in TSP-1 null conjunctiva have differential effects on the secretion of mucins produced by GCs in response to cholinergic stimulus resulting in altered tear quality.

Author Disclosure: DoD grant W81XWH-10-1-0392
Title: The impact of storage temperature and storage media on cultured human limbal epithelial cells

Authors: Tor P. Utheim\textsuperscript{1}, Øygunn A. Utheim\textsuperscript{1}, Jon R. Eidet\textsuperscript{1}, Borghild Roald\textsuperscript{1}, Maria de La Paz\textsuperscript{2}, Darlene A. Dartt\textsuperscript{3}, Torstein Lyberg\textsuperscript{1}.

Affiliation: \textsuperscript{1}Oslo University Hospital, Oslo, Norway, \textsuperscript{2}Barraquer institute, Barcelona, Spain; \textsuperscript{3}Schepens Eye Research Institute, Massachusetts Eye and Ear, Harvard Medical School, Boston, MA.

Background: The feasibility of storage of cultured human limbal epithelial cells (HLEC) for some days in a sealed container gives increased flexibility for scheduling operations, allows time for transportation to eye clinics without cell culture facilities as well as enables quality control, including microbiological assessment.

Aim: To study the effects of temperature and media on storage of cultured HLEC for four days.

Method: HLEC cultures were stored in Optisol-GS, HEPES-MEM and Quantum 286 (a serum containing medium) for four days at 23°C. In addition, cultured HLEC was subjected to conventional cold storage (5°C) in Optisol-GS for four days. The analyses included light microscopy, immunohistochemistry and a calcein-acetoxyethyl ester/ethidium homodimer-1 viability assay.

Results: Storage of cultured HLEC in Optisol-GS for four days at 5°C demonstrated extensive detachment of cells and low viability (55.0%). In contrast, cultured HLEC stored in HEPES-MEM, Optisol-GS and Quantum 286 for four days at 23°C were well preserved. Compared to unstored cells, the viability was only maintained after storage in HEPES-MEM (97.3%) and Quantum 286 (94.6%). Optisol-GS storage at 23°C yielded considerably higher viability (91.5%) than storage at 5°C. The epithelial thickness of cultured HLEC was maintained after storage in all media, except Optisol-GS. The phenotype, assessed by markers of differentiation, proliferation and progenitor cells, was maintained following storage at 23°C in all storage groups.

Conclusion: Serum-free storage of cultured HLEC for four days is best performed in HEPES-MEM at 23°C.

Author Disclosure: Tor P Utheim (P)
Title: A novel transportation system for cultured human limbal epithelial cells

Authors: Tor P. Utheim, Øygunn A. Utheim, Jon R. Eidet, Edward Messelt, Borghild Roald, Maria de La Paz, Darlene A. Dartt, Torstein Lyberg.

Affiliation: 1Oslo University Hospital, Oslo, Norway, 2Barraquer institute, Barcelona, Spain; 3Schepens Eye Research Institute, Massachusetts Eye and Ear, Harvard Medical School, Boston, MA.

Background: As regenerative medicine gains momentum reliable methods for cell transportation becomes more important.

Aim: To investigate the effects of transportation simulations on cultured human limbal epithelial cells (HLEC).

Method: Three-weeks HLEC cultures were divided into five experimental groups; all involving storage in sealed containers with HEPES-MEM for four days. To avoid an air-fluid interface all storage containers were completely filled with medium, except the group four containers (only ⅔ full). Group one (control) was not subjected to transportation simulations. The group two cultures were agitated for six hours at 200 rotations per minute (rpm) using an orbital shaker. Orbital shaking (200 rpm) of groups three, four and five lasted for 36 hours. In group five, Pluronic F-68 was added to the storage medium. The analyses included transmission electron microscopy, immunohistochemistry and a calcein-acetoxymethyl ester/ethidium homodimer-1 viability assay.

Results: HLEC morphology appeared unchanged in all but group four, where the number of desmosomes and hemidesmosomes was significantly lower than in the other groups. The number of cell layers (2.8 - 3.5), cell viability (96.4% - 97.5%) and cell phenotype did not demonstrate any significant differences between the five experimental groups.

Conclusion: HLEC subjected to storage in HEPES-MEM for four days at 23°C withstand transportation simulations as long as the storage containers are completely filled with medium. We hypothesize that the lack of an air-liquid interface in the container reduces mechanical stress, i.e. shearing forces exerted on the cells.

Author Disclosure: Tor P Utheim (P)
Title: Preservation of cultured human retinal epithelial cells

Authors: Tor P. Utheim¹,², Lara Pasovic¹, Edward Messelt¹, Torstein Lyberg¹, Dong Feng Chen², Peder Aabel¹, Xiangjun Chen¹,² and Jon R. Eidet¹

Affiliation: ¹Oslo University Hospital, Oslo, Norway, ²Schepens Eye Research Institute, Massachusetts Eye and Ear, Harvard Medical School, Boston, MA.

Background: Recent advancement of cell therapy for major blind-causing diseases by retinal pigment cell (RPE) transplantation demands for the establishment of RPE storage techniques.

Aim: To investigate the effects of temperature on 1-week storage of cultured RPE cells.

Method: The RPE cell line, ARPE-19 cells, were seeded on Nunclon Δ-surface multidishes and cultured until confluence. The cells were stored in HEPES-MEM at nine temperatures (4°, 8°, 12°, 16°, 20°, 24°, 28°, 32°, and 37°C) for seven days. Viability and phenotype were assessed by epifluorescence microscopy and a microplate fluorometer, while the morphology of cultured RPE cells was analyzed by scanning and transmission electron microscopy.

Results: Viability was reduced in all storage groups compared with unstored control cells. Cell survival was highest after storage at 12°, 16° and 20°C, with superior viability at 16°C (49% ± 9.9% compared with unstored cells; P < 0.05 compared to 4°, 8°, 12°, 24°, 28°, 32° and 37°C). Only cells stored at 16°C appeared morphologically similar to unstored cells. The phenotype was mostly unchanged following storage at 12°, 16° and 20°C.

Conclusion: The study demonstrates that storage temperature has a crucial impact on viability and behaviour of RPE cells. We have identified a narrow temperature range (16°-20°C) that spurs cell survival, preserves cell morphology, and maintains proliferative ability and differentiation levels.

Author Disclosure: None
Poster #38

Title: Retinopathy of Prematurity Trainer

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Background: Retinopathy of prematurity (ROP), the leading cause of preventable blindness in infants, is a disease of the retinal vessels that can occur in a premature baby, particularly in newborns less than 1500g of birth weight and or less than 30 weeks of gestational age. Undiagnosed or untreated ROP has a 48% risk of an unfavorable outcome. Timely treatment can decrease the rate of unfavorable outcome to 9%.

Aim: Our goal is to develop a tool that will help to teach residents, fellows and ophthalmologists how to examine premature infants, recognize and stage ROP through a computer based simulation. The task of screening all at-risk infants poses manpower challenges, as there is a shortage of specialized ophthalmologists. Outside of medical centers, there may be no ophthalmologists with experience in ROP. Many physicians do not perform ROP screening for fear of litigation. Very few ophthalmology residency programs provide this specialized training.

Method: We are developing a computer based teaching tool, based on current educational concepts, that will enhance learning of ROP. By using this tool learners will have the opportunity to see the stages of ROP in digital pictures and videos, and to watch ROP experts explaining both the key aspects of the disease and controversial issues. The learners will be prompted to classify cases and if incorrect, an explanation will be provided.

Results: The program will consist of several sections, each with a different pedagogical design. The interactive exercises covering screening, exam prep, the examination, fundus findings, staging will be the core of the simulation. Moreover, the interactive clinical case studies will help the learner to understand step by step view of the elements of ROP medicine from screening through classification and treatment.

Conclusion: Our computer based teaching program has potential to improve accessibility and quality of care for premature patients, the cost of ROP management as well as diagnostic accuracy and uniformity.

Author Disclosure: Authors have no financial interest.
Title: Remotely Operated Stereo Slit-Lamp: Imaging Inaccessible Patients with Limited Network Infrastructure

Authors: J-M Parel, D Nankivil, A Gonzalez, C Rowaan, W Lee, I Nose, M Aguilar, S Yoo, A Moshfeghi, D Budenz

Affiliation: Ophthalmic Biophysics Center, Bascom Palmer Eye Institute, UMMSM.

Background: Evacuation of a military patient entails enormous logistical coordination while under the threat of hostile enemy action. A remotely-operated and rapid tridimensional slit-lamp (SL) examination of the anterior segment of an injured eye will help save a soldier’s vision in the battlefield.

Aim: To develop a remotely operated SL for imaging patients in inaccessible clinical settings and to evaluate the feasibility of transmitting live ophthalmic stereoscopic images along with bi-directional audio communication, over a network connection.

Method: A SL was configured with two high resolution CCD camera (3.1 Mp) and computer controlled motorized magnification (5-30x), X-Y-Z, slit angle, width, height, and intensity controls that includes clinician-patient VoIP communication and a patient overview video. A mixed video stream containing both ocular videos, external overview, and user interface indicators; all compressed using a hardware encoder. Stereo fusion is achieved by prismatic glasses. In cases of intermittent satellite communication, autonomous functionality for several of the SL operations was developed. Data is stored for transmission once satellite link resumes.

Results: Under an IRB approved protocol the robotized SL was remotely operated from North and South America, Europe and Africa, acquiring real-time high definition imaging in all subjects. Connection speeds (LAN/internet/satellite) ranged from 20Mbps-307Kbps with a latency of 1500ms to 100ms.

Conclusion: The robotized remotely operated SL allows stereo-viewing and recording of the patient’s eyes via global computer networks with limited infrastructure. Standard ophthalmic exams can be conducted from inaccessible locations.

Author Disclosure: None

Acknowledgements: DOD Grant DAMD-W81XWH-09-1-0675; FLEB; NIH Center Grant P30EY14801; RPB; Henri and Flore Lesieur Foundation (JMP).
Poster #40

Title: Portable Supine SD-OCT System for Perioperative Imaging of Pediatric Patients

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Background: Spectral Domain Optical Coherence Tomography (SD-OCT) is a proven, well-established imaging modality for the diagnosis of ophthalmic diseases. Acquiring diagnostic images in pediatric patients of varying ages using a conventional system has proven to be cumbersome and complicated.

Aim: To construct a portable supine SD-OCT system to image pediatric patients perioperatively.

Method: A Zeiss S5 OPMI stand was adapted to accept a customized motorized X-Y adjustment system and a stepper-based Z-motion mechanism that provides fine adjustments; a 4\textsuperscript{th} generation hand-held SD-OCT probe (Bioptigen) was mounted to a goniometric cradle. The system has a total 5\textdegree of freedom: X, Y, Z, yaw, and roll to image a designated area on the retina. Under an IRB approved protocol, 14 pediatric undergoing diagnostic EUA (ERG, RetCam) and 22 adult patients were imaged utilizing the portable supine SD-OCT.

Results: The portable supine SD-OCT was able to obtain high quality retinal scans in all pediatric as well as adult patients.

Conclusion: The portable supine SD-OCT system provides accurate positioning of the 4\textsuperscript{th} generation hand-held SD-OCT probe and easily obtains images of pediatric patients in the OR. The current system is undergoing retrofitting to adapt a 5\textsuperscript{th} generation hand-held SD-OCT probe recently designed by Bioptigen.

Author Disclosure: Andres Bernal is an employee of BIONIKO Consulting LLC; the remaining authors have no disclosures.

Acknowledgements: DOD Grant DAMD-W81XWH-09-1-0675; Bioptigen; FLEB; NIH Center Grant P30EY14801; RPB; Henri and Flore Lesieur Foundation (JMP).
Title: Advances in Modified Osteo-Odonto Keratoprosthesis technique (MOOKP) for the Treatment of Combat Related Corneal Blindness

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Background: MOOKP is used to restore vision in patients with severe ocular trauma and burns, end-stage Steven-Johnson syndrome and ocular cicatricial pemphigoid. However, technically it is very difficult. First, the lamina has to be shaped manually and high temperature could damage the tissue. Second, the acrylic bonding agent commonly used to cement the optical cylinder and canine needs to be manually mixed and long term efficacy is questionable.

Aim: To fabricate a mill to easily and safely shape the lamina and to compare the efficacy of 2 novel bonding agents to dental acrylic.

Method: An autoclavable micro-mill was built and K-Pro laminas were created using extracted canines. The temperature was monitored internally. The strengths of cyanoacrylate adhesive (Histoacryl), a 2-parts bone cement (Stryker) and the acrylic (Jet) were compared. 4 laminas/agent immersed in BSS maintained at 36°C since 11/7/2011 were monthly subjected to a 1kg force (IOP equivalent =>200mmHg).

Results: The MOOKP micromill was shown to be as efficacious as the manual technique, as it took less than 10mins to create a lamina. Moreover, the canine’s canal temperature never exceeded 38°C whereas with the manual technique, it exceeded 69°C. None of the 12 cemented laminas failed the force tests at 10 months.

Conclusion: The MOOKP micro-mill is safer and more efficient than the manual technique. Furthermore, the single component medical grade cyanoacrylate can replace the 2-components dental acrylic adhesive. These two new observations can simplify the MOOKP procedure, maintaining its safety and good results.

Author Disclosure: DAMD-W81XWH-09-1-0675, NIHR01EY018624-04+CenterGrantP30EY14801, FLEB, Henri & Flore Lesieur Foundation(JMP), RPB PhysicianScientistGrant(VLP).
Title: Stromal cell-derived factor-1 (SDF-1) contributes to inflammation-induced optic nerve regeneration and retinal ganglion cell survival

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Background: Although mature retinal ganglion cells (RGCs) normally cannot regenerate injured axons, intraocular inflammation partially reverses this situation, enhancing the ability of RGCs to survive injury and regenerate lengthy axons beyond the injury site. Previously, we identified oncomodulin (Ocm) as the principal mediator for the regeneration.

Aim: To investigate if the chemokine SDF-1 contributes to the RGC survival and nerve regeneration after the inflammation.

Method: We used real-time RT-PCR technique and immunostaining to study SDF-1’s expression in eye after intraocular inflammation. For testing SDF-1’s effects, we used a RGC primary culture system and an in vivo optic nerve crush model. In the loss of function studies, we used AMD3100, an antagonist of SDF-1 receptor CXCR4, or a neutralizing antibody to SDF-1, to evaluate the roles of SDF-1 in the inflammation-induced RGC survival and optic nerve regeneration.

Results: In RGC cultures, SDF-1 induced a modest amount of axon growth on its own and, like Ocm, its effects were enhanced by mannose, an abundant constituent of vitreous, and elevation of cAMP. In addition, with these co-factors, SDF-1 enhanced the effects of Ocm. In vivo, the intraocular inflammation elevates SDF-1 mRNA and protein levels in the cells that infiltrate into the eye. The exogenous SDF-1 promoted some regeneration and RGC survival on its own, while further enhancing the effects of the inflammation. Conversely, AMD3100 suppressed the effects of intraocular inflammation as well as the normal survival of RGCs. The pro-survival effect of SDF1 in the normal retina was further confirmed by using a neutralizing antibody to SDF1.

Conclusion: SDF-1 enhances both axon regeneration and RGC survival after intraocular inflammation; it also plays an important role for the normal survival of RGCs.

Author Disclosure: none
Sponsored by

Schepens Eye Research Institute, Mass. Eye and Ear, Harvard Medical School

United States Army Medical Research & Materiel Command (USAMRMC)

Telemedicine & Advanced Technology Research Center (TATRC)

DOD-VA Vision Center of Excellence (VCE)

The 5th Military Vision Symposium on Ocular & Vision Injury gratefully acknowledges the support of our corporate sponsors: