The Mass. Eye and Ear logo signifies the sun rising over rolling ocean waves, suggesting sight and sound.
# Table of Contents

**Letter from the Chair** ......................................................... 2  
**About this Quality and Outcomes Report** .................. 4  
**Mass. Eye and Ear Overview** ........................................ 8  
  - **Key Statistics: Ophthalmology** ................................ 12  
  - **Ophthalmology Resource Centers** .......................... 15  
    - **Laser Center** ...................................................... 15  
    - **Ophthalmic Pathology** ...................................... 16  
    - **Ocular Surface Imaging Center** ............................ 20  
  - **Research** .............................................................. 22  
  - **Contact Lens** ........................................................ 24  
  - **Optical Shop** ......................................................... 25  
  - **International Program** ......................................... 26  
  - **Eye Anatomy** .......................................................... 28

**Subspecialty Services**
- **Comprehensive Ophthalmology and Cataract Consultation** ........... 29  
- **Glaucoma** ................................................................... 37  
- **Cornea and Refractive Surgery** .................................... 47  
- **Refractive Surgery** ..................................................... 56  
- **Ophthalmic Plastic and Reconstructive Surgery** .................... 67  
- **Retina** ......................................................................... 73  
- **Ophthalmic Oncology** .................................................. 96  
- **Retinal Degenerations/Electroretinography (ERG)** ............... 105  
- **Pediatric Ophthalmology and Strabismus** ................... 112  
- **Emergency Department/Eye Trauma Service** ............... 118  
- **Neuro-Ophthalmology** ............................................... 127  
  - **Boston Retinal Implant Project** ................................. 132  
- **Immunology and Uveitis** .............................................. 133  
- **Vision Rehabilitation** ................................................ 136  
- **Physician Directory** .................................................. 143
Physicians today want to practice evidence-based medicine so that we can diagnose and treat patients using the best available data. To accomplish this, we usually refer to randomized clinical trials in which carefully matched groups of patients are studied comparing an intervention, a drug or a surgery. Unfortunately, this level of data exists for very few medical decisions and, even when it does, it may not be helpful when considering options for an individual patient who doesn’t have the exact same characteristics as those who were enrolled in the clinical trials.

Another way to examine the effectiveness of our clinical practice involves studying outcomes. How effective are we, the Mass. Eye and Ear and Harvard Medical School’s (HMS) Department of Ophthalmology, when we treat patients with wet or neovascular age-related macular degeneration? How well do our patients see after cataract surgery? How often do patients develop post-operative infections? In other words, how well do our doctors, nurses and health care professionals manage their patients?

At Mass. Eye and Ear and HMS’s Department of Ophthalmology, we have more than a century of experience in leading the world in innovative approaches to eye disease. We founded subspecialty training in cornea, retina and glaucoma, and have developed new treatments for diseases ranging
from retinal detachment to corneal scarring to macular degeneration. Now we aim to lead the medical community in the development of outcome measures in ophthalmic care. How are we doing today and how can we improve patient outcomes in the future?

This Quality and Outcomes Report is a first, but important step. I would like to thank the Department of Ophthalmology’s Chief Quality Officer, Teresa C. Chen, MD, for her leadership in this project, as well as her team of faculty, administrators and trainees who helped initiate and contribute to this important endeavor.

For more information about Mass. Eye and Ear’s Quality Program or the Department of Ophthalmology, please visit our website at www.MassEyeAndEar.org.

Joan W. Miller, MD
Henry Willard Williams Professor of Ophthalmology
Chief and Chair, Department of Ophthalmology
Massachusetts Eye and Ear Infirmary
Massachusetts General Hospital
Harvard Medical School
The goal of Mass. Eye and Ear’s Quality Program is to provide the best patient-centered care delivered by the highest quality staff. An effective and sustainable quality improvement plan must be centered on best outcomes, service, patient safety, effective treatments, timely care, efficiency, equitable healthcare, and cost lowering. Excellence in future patient care will be achieved by education of future ophthalmic leaders and by research to develop better treatments.

Best quality is demonstrated by best outcomes. Our primary aim in collecting outcomes data is to drive quality improvement in order to deliver the best patient care possible utilizing state-of-the-art medicine and technology. In this report, we aimed for transparency — describing data from all of our hospital’s subspecialty services, as well as reporting the results of all of our major clinical and surgical procedures.

Most of the data provided in this report reflects patient outcomes during a one-year period from 2008 to 2009, with specific months stated in the text. Although most of this year’s data was collected retrospectively, our hope is that future outcomes reports will describe data that are prospectively and electronically collected. In addition to participating in the Physician Quality Reporting Initiative (PQRI), our hospital
has both electronic medical records and electronic prescription capabilities. We anticipate that future
technology advances will facilitate measurements of patient care outcomes from year to year.

It is important to note that the information contained in this outcomes book focuses primarily on the
work of the full-time staff at Mass. Eye and Ear’s main Boston campus, unless otherwise stated.

A PDF version of this report is available on our website at www.MassEyeAndEar.org.

I would like to acknowledge Mass. Eye and Ear’s President and CEO, John Fernandez, who had the
vision to establish highest quality care as a top priority so that we can continue to provide the
exceptional ophthalmic care that has become a hallmark of our institution. Finally, I would like to
acknowledge Joan W. Miller, MD, Chair of the Department of Ophthalmology at HMS, who first
introduced the idea of producing an outcomes book at Mass. Eye and Ear and who helped lead our
hospital in this important initiative.

**Teresa C. Chen, MD**

*Associate Professor of Ophthalmology, Harvard Medical School*

*Chief Quality Officer, Department of Ophthalmology, Massachusetts Eye and Ear Infirmary*
Contributors


Data collection by residents and research fellows:
Ahmed Soliman, Noelle Layer, Miriam Englander, Glenn Yiu, Farooq Khan, Jared Ament, Andrea Giani, Yan Zhang

Medical illustrations by Laurel Cook Lhowe

Design by Marc Harpin, Rhumba
Founded in 1824, the Massachusetts Eye and Ear Infirmary is a pre-eminent specialty, teaching and research hospital dedicated to caring for disorders of the eye, ear, nose, throat, head and neck. Our dedicated staff provides primary and subspecialty care and serves as a referral center for inpatient and outpatient medical and surgical care. Mass. Eye and Ear is the leading authority in its specialties throughout the northeast and is a resource globally for advances in patient care, research and education.

As the primary academic center for Harvard Medical School’s Departments of Ophthalmology and Otolaryngology, we are deeply committed to providing a superb education to the next generation of health care vision leaders. Our world-renowned experts are continuously innovating in the fields of translational and bench research, turning insights into cures that benefit scores of people. We continue to forge new partnerships and alliances — locally, nationally and beyond our borders — to increase our reach and make our expertise, services and resources available to all who need them.

Pivotal to our clinical quality efforts is the use of the Longitudinal Medical Record (LMR), an integrated and secure system of communication and medical record sharing among the majority of Harvard Medical School’s network of 17 hospitals and affiliates. This network facilitates quick and easy communication among referring physicians and Mass. Eye and Ear’s consulting ophthalmologists. It also enables our physicians to instantly tap our in-house specialists, affording seamless and rapid access to some of the best ophthalmic resources available.
Mass. Eye and Ear Department of Ophthalmology
- Primary teaching hospital of the Harvard Medical School Department of Ophthalmology

Clinical Affiliations
- Massachusetts General Hospital Department of Ophthalmology
- Brigham and Women’s Hospital
  - trauma coverage, inpatient, outpatient clinical services
- Children's Hospital Ophthalmology Foundation (CHOF), Boston
  - Mass. Eye and Ear ophthalmologists provide specialty pediatric eye care at Children’s Hospital in collaboration with CHOF
  - CHOF ophthalmologists staff comprehensive pediatric ophthalmology and strabismus clinic at Mass. Eye and Ear

Academic Affiliations
- Massachusetts General Hospital
- Brigham and Women’s Hospital
- Beth Israel Deaconess Hospital
- Joslin Diabetes Clinic
- Children’s Hospital Boston
- Boston Veterans’ Administration
- Togus, Maine Veterans’ Administration
- Schepens Eye Research Institute
- Aravind Hospital, India
Resources at Mass. Eye and Ear

- Full spectrum of primary and subspecialty ophthalmic care
- Investment in advanced technology for corneal and retinal imaging, laser and conventional surgery, longitudinal medical records and e-scribing.
- Mass. Eye and Ear Medical Unit, staffed by MGH physicians
- Mass. Eye and Ear Radiology Department
- The David Glendenning Cogan Laboratory of Ophthalmic Pathology, in conjunction with the MGH Surgical Pathology Service.
- The Howe Library houses one of the most extensive ophthalmology research collections in the world.
- Twenty-four hour/seven-days-a-week pharmacy, specializes in ophthalmology medications like oral glycerin, fortified topical antibiotics, pediatric acetazolamide suspension, etc.
- Anesthesia and nursing staff with ophthalmology specialization
- Dedicated social work department
Mass. Eye and Ear Chief of Ophthalmology
Dr. Joan W. Miller examines a patient with macular degeneration.
# Key Statistics: Mass. Eye and Ear Ophthalmology

**Outpatient Ophthalmology Visits**

*October 2008 - September 2009*

**Mass. Eye and Ear (Boston)**

<table>
<thead>
<tr>
<th>Subspecialty</th>
<th>Patient Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comprehensive Ophthalmology</td>
<td>22,736</td>
</tr>
<tr>
<td>Emergency Department</td>
<td>12,239</td>
</tr>
<tr>
<td>Trauma</td>
<td>865</td>
</tr>
<tr>
<td>Cornea</td>
<td>9,751</td>
</tr>
<tr>
<td>Refractive Surgery</td>
<td>2,316</td>
</tr>
<tr>
<td>Contact Lens Service</td>
<td>3,930</td>
</tr>
<tr>
<td>Ophthalmic Plastic, Reconstructive Surgery</td>
<td>5,280</td>
</tr>
<tr>
<td>Glaucoma</td>
<td>12,887</td>
</tr>
<tr>
<td>Pediatrics and Strabismus</td>
<td>3,344</td>
</tr>
<tr>
<td>Immunology and Uveitis</td>
<td>3,910</td>
</tr>
<tr>
<td>Electroretinography</td>
<td>886</td>
</tr>
<tr>
<td>Neuro-Ophthalmology</td>
<td>4,356</td>
</tr>
<tr>
<td>Retina</td>
<td>15,929</td>
</tr>
<tr>
<td>Vision Rehabilitation Service</td>
<td>1,423</td>
</tr>
</tbody>
</table>

**Total Outpatient Ophthalmology Visits**

<table>
<thead>
<tr>
<th>Location</th>
<th>Patient Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stoneham</td>
<td>3,029</td>
</tr>
<tr>
<td>East Bridgewater <em>(opened May 2009)</em></td>
<td>313</td>
</tr>
<tr>
<td>Longwood <em>(opened July 2009)</em></td>
<td>77</td>
</tr>
</tbody>
</table>

**Total Mass. Eye and Ear Outpatient Visits**

*(Boston and Other Locations)*

<table>
<thead>
<tr>
<th>Patient Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>103,271</td>
</tr>
</tbody>
</table>
Emergency Room Visits

October 2008 - September 2009

Total number of Ophthalmology patients .................................................12,239

Surgical Procedures

October 2008 - September 2009

Total surgeries ...........................................................8,418
Total laser procedures ..................................................2,745
  Laser Surgery ...........................................................1,609
  PDT .................................................................159
  Refractive .............................................................977
Total intravitreal injections ........................................2,175

Major Ophthalmology Imaging/Radiology

July 2008 - June 2009

Scans performed by Radiology Service ......1,153
  CT scans .................................................................728
  MRI .................................................................408
  X-rays .................................................................17

Minor Ophthalmology Imaging/Testing

October 2008 - September 2009

Angiograms ..........................................................1,645
Imaging tests (e.g., optical coherence
tomography imaging) ........................................8,449
Ultrasound testing (e.g., Bscan) .........................7,456
Electroretinograms (ERG and Retina Service) ....898
  Related testing ......................................................3,569
Visual field testing (# of patients) .................9,513
This is a photograph of a colony of cells that comes from a single stem cell.

Picture courtesy Ula Jurkunas, MD
The Morse Laser Center (twelfth floor)
For more than 25 years, Mass. Eye and Ear’s highly skilled physicians have routinely performed laser procedures using the most advanced techniques and technology available today. The Morse Laser Center (twelfth floor) houses our state-of-the-art laser equipment and includes:

Refractive lasers:
- Star S4 Excimer Laser (VISX/AMO)
- Allegretto Eye-Q Excimer Laser (Wavelight)
- FS 30 Diode Laser (Intralase)

Glaucoma lasers:
- Selecta 7000 YAG laser (Lumenis) for selective laser trabeculoplasty
- Diode Oculight (Iridex) for transscleral cyclophotocoagulation

Retinal lasers:
- Green (532 nm) YAG Laser (Pascal)
- 689-NM Red Opal Photo Activator (Lumenis)
- Novis Omni Argon (blue/green 670 nm, yellow 577 nm) laser (Lumenis)

Anterior segment laser:
- Aura Nd:YAG laser (Lumenis)

First Floor Laser Suite
Most of our anterior segment services are on the first floor. To better accommodate our ophthalmology patients and anterior segment physicians, we recently opened up a new laser suite on the first floor which houses two lasers:
- Aura PT Nd:YAG Laser System (Lumenis)
- Oculight Argon 532 nm Green Laser System (Iridex)
The David Glendenning Cogan Laboratory of Ophthalmic Pathology at the Mass. Eye and Ear pools resources with the Massachusetts General Hospital’s Surgical Pathology division to enhance diagnostic services, resident and fellow teaching, and clinico-pathologic research projects. The laboratory has a rich leadership tradition that includes such luminaries as Frederick Verhoeff, David Cogan, Taylor Smith and Daniel Albert. The current eye pathology staff has published over 600 articles and book chapters covering a wide gamut of subjects that contribute to a formidable collective diagnostic expertise and clinical experience. The full spectrum of diagnostic methods and subspecialty staff (skin, soft tissue and bone, lymphoma, neuropathology) in Surgical Pathology at the Massachusetts General Hospital are available to facilitate the diagnostic and research work of the Ophthalmic Pathology Laboratory.

The Cogan Laboratory welcomes outside glass slides for consultations and tissue in formalin for processing and diagnosis.

**Select Resources/Services**

- Multi-headed light microscope for simultaneous viewing of slides by up to 10 students, faculty and practitioners
- Histochemical staining for calcium, iron, copper, fat, glycogen, bacterial and fungal organisms, parasites, mucosubstances, melanin, amyloid, and neuroendocrine granules (special stains
include, among others, Masson trichrome, von Kossa, rhodamine, Prussian blue, alcian blue, mucicarmine, periodic acid Schiff, Brown-Hopps, Warthin-Starry, Ziehl-Neelsen, Fite, Grocott methenamine silver, Grimelius, Fontana-Masson, Verhoeff-van Gieson, Congo red, oil-red O)

- Immunoperoxidase staining for viruses (herpes family) and for epithelial, metastatic, lymphomatous, melanomatous, and sarcomatous tumor diagnosis (among other probes, monoclonal and polyclonal antibodies are employed for identifying cytokeratins, Ber-EP4, GCDFP-15, carcino-embryonic antigen, epithelial membrane antigen, HMB-45, MART-1, S-100, chromogranin, synaptophysin, GFAP, TTF1, MDM2, neurofilament, myosin, myogenin, myoglobin, desmin, smooth muscle actin, Ki-67, D2-40, CD34, Glut-1, CD3/5, CD10, CD20, bcl2, cyclinD, kappa and lambda light chains, CD68, lysozyme)

- Transmission electron microscopy
# Ophthalmology Resource Centers: Ophthalmic Pathology Service

*October 2008 - September 2009*

<table>
<thead>
<tr>
<th>SPECIMEN</th>
<th>NUMBER</th>
<th>PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eyelids</td>
<td>1060</td>
<td>30.2%</td>
</tr>
<tr>
<td>Conjunctiva</td>
<td>335</td>
<td>9.4%</td>
</tr>
<tr>
<td>Corneas</td>
<td>244</td>
<td>6.8%</td>
</tr>
<tr>
<td>Glaucoma</td>
<td>66</td>
<td>1.8%</td>
</tr>
<tr>
<td>Orbital tissues, including bone and lacrimal sac</td>
<td>240</td>
<td>6.7%</td>
</tr>
<tr>
<td>Vitreous and other cytologic specimens</td>
<td>137</td>
<td>3.8%</td>
</tr>
<tr>
<td>Enucleated eyeballs and eviscerations</td>
<td>145</td>
<td>4.0%</td>
</tr>
<tr>
<td>Exenterated orbital contents</td>
<td>18</td>
<td>0.5%</td>
</tr>
<tr>
<td>Histochemical and immunoperoxidase studies</td>
<td>1038</td>
<td>29.3%</td>
</tr>
<tr>
<td>Gross examination only</td>
<td>148</td>
<td>4.1%</td>
</tr>
<tr>
<td>Electron microscopic studies</td>
<td>15</td>
<td>0.4%</td>
</tr>
<tr>
<td>Outside referrals for consultation</td>
<td>110</td>
<td>3.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,556</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
Mushroom-shaped primary intraocular melanoma of the choroid

Photo courtesy of Rebecca Stacy, MD, PhD and Frederick A. Jakobiec, MD
Confocal microscopes are available at the Mass. Eye and Ear Ocular Surface Imaging Center (OSIC), which provides non-invasive biopsy of the cornea.

In addition to a standard Confoscan 4, we are utilizing a new, cutting-edge laser scanning confocal microscope: the Heidelberg Retina Tomograph (HRT) 3, with the Rostock cornea module (RCM). The HRT/RCM allows a layer-by-layer analysis of the cornea with an optical resolution of 1 µm. One important clinical application of in vivo confocal microscopy is that it allows for early detection and diagnosis of Acanthamoeba and fungal keratitis which often masquerade as bacterial or viral infections. This not only decreases the need to wait for results of traditional corneal scraping tests but also allows for earlier sight-saving treatments to patients.

Additional equipment available at the OSIC includes:

- An Orbscan and Pentacam for corneal topography
- A Haag-Streit digital slit-lamp photography and video unit
- A specular microscope
- An RTVue-100 Fourier-Domain Optical Coherence Tomograph (OCT, Optovue), which allows for non-invasive, real-time cross-sectional views of the cornea, conjunctiva, and the angle.
Mass. Eye and Ear and its affiliates employ basic scientists, clinician researchers, postdoctoral fellows, clinical coordinators, and research assistants who participate in basic science, translational and clinical research. A diverse and robust research portfolio reflects the high caliber of our research program and the immensely creative and innovative work of our researchers and clinicians. From October 2007 to September 2008, total federal research funding from the National Institute of Health (NIH) exceeded $26 million for the Harvard Department of Ophthalmology.

Physician-scientists from Mass. Eye and Ear’s Clinical Research Program conduct innovative translational and clinical research that support the prevention, treatment and cure for disorders of the eye. Clinical research studies test how well new medical approaches work in people by answering scientific questions that aim to find better ways to prevent, screen for, diagnose, and treat a specific disorder. Our ultimate goal is to translate bench research into “bedside” therapies and cures that benefit patients directly.

All of our trials undergo a rigorous review process conducted by the Mass. Eye and Ear Human Studies Committee. People who take part in our clinical trials have an opportunity to contribute to knowledge of their specific disorder while receiving the most up-to-date medical care.
Dr. Ula Jurkunas (second from left) and her cornea research team.
Mass. Eye and Ear’s Contact Lens Service staff offers extensive knowledge of contact lens fitting methods, techniques, and newly available lens modalities. The Service provides a wide array of contact lens options, often successfully fitting patients who previously could not wear lenses.

Over the years, extensive research in contact lens use has led to a plethora of new technology, spurring the development of a new generation of lens types that address many visual problems. Mass. Eye and Ear’s Contact Lens Service staff can expertly assess and prescribe contact lenses for all the specialty uses below.

- Contact Lenses for Astigmatism
- Bifocal Contact Lenses
- Color Enhancing Contact Lenses
- Contact Lenses for Dry Eyes
- Contact Lenses for Color Deficient Patients
- Prosthetic Contact Lenses
- Post-Surgical and Post-Trauma Contact Lenses
- Specialty Lenses for Keratoconus and Corneal Irregularities

contact lens fitting

- Number of contact lens fitted and ordered: 3,815
- Therapeutic fits, bandage lenses, and aphakic correction: 1,111

October 2008 to September 2009
The Mass. Eye and Ear Optical Shop offers a full-range of comprehensive optical services, from routine fittings to filling prescriptions for highly specialized eyewear. Our highly-trained, licensed and skilled opticians have extensive experience filling difficult or unusual prescriptions while working closely with physicians from our ophthalmic specialty services. Our optical team is committed to service excellence and takes pride in their outstanding quality of work, depth of knowledge and experience, and high degree of customer satisfaction.

The shop carries a wide-range of accessories including Fresnel prisms, Bangerter occlusion foils, ptosis crutches, moisture chambers and an array of clip-ons, flip-ups, cleaners and cords. Our staff provides prompt response to inquiries and also offers free adjustments, minor repairs, and complimentary cleanings. The Optical Shop also has an on-site finish lab for the highest quality eyewear.

*Total Eye Glasses Dispensed: 2,917

*October 2008 to September 2009*
Each year, Mass. Eye and Ear staff welcomes and treats patients from all over the world. Recognizing the unique requirements of our international guests, Mass. Eye and Ear established an International Patient Office in 1996 to better serve this patient population and to help coordinate their visits.

We offer on-site language translation services for many languages. If a live interpreter is not available, the International Office can arrange for telephone conference translation services through AT&T's Language Line. This service offers translation assistance in 35 different languages and is readily available to patients and physicians 24 hours a day, seven days a week.

**Number of Interpreter Usages by Mass. Eye and Ear Patients**

**In-person**
- Ophthalmology outpatient visits .......................................................... 1,484
- Emergency Department ........................................................................... 343
- Operating rooms/surgeries ................................................................. 220

**Telephone conference**
- AT&T Language Line service .............................................................. 1,095
<table>
<thead>
<tr>
<th>Albanian</th>
<th>Italian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amharic</td>
<td>Japanese</td>
</tr>
<tr>
<td>Arabic</td>
<td>Korean</td>
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<tr>
<td>ASL American Sign Language</td>
<td>Lebanese</td>
</tr>
<tr>
<td>Bengali</td>
<td>Persian</td>
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<tr>
<td>Bosnian</td>
<td>Polish</td>
</tr>
<tr>
<td>Burmese</td>
<td>Portuguese</td>
</tr>
<tr>
<td>Cambodian</td>
<td>Russian</td>
</tr>
<tr>
<td>Cantonese / Mandarin</td>
<td>Serbo-Croatian</td>
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<tr>
<td>Ethiopian</td>
<td>Somali</td>
</tr>
<tr>
<td>Farsi</td>
<td>Spanish</td>
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<tr>
<td>Filipino</td>
<td>Swahili</td>
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<tr>
<td>French</td>
<td>Thai</td>
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<tr>
<td>German</td>
<td>Tibetan</td>
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<tr>
<td>Greek</td>
<td>Turkish</td>
</tr>
<tr>
<td>Haitian/Creole</td>
<td>Urdu</td>
</tr>
<tr>
<td>Hebrew</td>
<td>Vietnamese</td>
</tr>
</tbody>
</table>
Eye Anatomy

- Cornea
- Lens
- Pupil
- Iris
- Sclera
- Retina
- Macula
- Vitreous
- Optic nerve
The Comprehensive Ophthalmology team provides a full spectrum of integrated patient care, from annual eye exams and continued ophthalmology care, to subspecialty referrals. There are more than 20,000 patient visits to our Comprehensive Ophthalmology Service each year. Our services range from routine eye care and screenings for systemic diseases like diabetes, to the management of complex ophthalmic diseases such as cataracts and glaucoma. In addition, we have dedicated services to offer Vision Care for the Deaf in our main campus location.

**Select Resources**

- Humphrey Visual Field Analyzer (Zeiss)
- Heidelberg Retinal Tomograph with a HRT retina imaging module (Heidelberg)
- Epic 2000 Refracting Station (Nidek)
- IOL Master (Zeiss)
- Contact Ascan (Sonomed)
- Ultrasonic Pachymeter/Pachette (DGH Technologies)
- ARK 530 A Auto Refractor/Kearatometer (Nidek)
The most common surgery performed by Mass. Eye and Ear’s Comprehensive Ophthalmology Service is cataract extraction with intraocular lens implantation. For all locations (Mass. Eye and Ear main campus as well as other locations), there were 1,109 cataract surgeries performed during the July 2008 to June 2009 period. The outcomes of the 974 cataract surgeries performed on patients seen at the main Boston campus and on patients with sufficient follow-up for analysis are described here.

Another common surgical procedure performed by our comprehensive ophthalmologists is pterygium surgery, the outcomes of which are also reported.
Cataract Surgery:
Visual acuity improvement by three months follow-up

July 2008 to June 2009

The chart below depicts the results of 974 cataract surgeries that were performed on patients who were seen at the Mass. Eye and Ear main Boston campus and who had sufficient follow-up for analysis.

Over 80% of patients undergoing cataract surgery enjoy more than 5 letters of visual acuity improvement.

Number of letters improved in the eye chart

N = 974

Chart showing the distribution of visual acuity improvement for 974 cataract surgeries.
The chart below depicts the results of 974 cataract surgeries that were performed on patients who were seen at the Mass. Eye and Ear main Boston campus and who had sufficient follow-up for analysis.

Cataract Surgery: Difference between actual and target refraction (spherical equivalent) by three months follow-up

July 2008 to June 2009

92% of cataract patients achieved within 1 diopter of target refraction after cataract surgery. These surgical results exceed national and international benchmarks.

Benchmark for refractive outcome after cataract surgery (75% to 90%)

References for Benchmark:
Depicted below are the intra-operative complications of the 974 cataract surgeries that were performed on patients who were seen at the Mass. Eye and Ear main Boston campus and who had sufficient follow-up for post-operative analysis.

Over 95% of cataract surgery patients had no intra-operative complications.
Depicted below are the post-operative complications of the 974 cataract surgeries that were performed on patients who were seen at the Mass. Eye and Ear main Boston campus and who had sufficient follow-up for analysis.

Over 97% of cataract surgery patients had no post-operative complications.
The graph below depicts the outcomes of pterygium surgery performed at Mass. Eye and Ear. Twenty-five surgeries were performed during a one-year period, but two cases did not have sufficient follow-up for outcomes analysis. Of the 23 remaining patients that had three months of follow-up data, none had experienced a recurrence of the excised pterygium at their three month follow-up.

Pterygium Surgery: Pterygium recurrence at three months follow-up

July 2008 to June 2009

100% of patients having pterygium surgery achieved surgical success at 3 months.

Surgical success is defined as no pterygium recurrence at three months.

N = 23
Glaucoma is a group of disorders in which the main risk factor is high eye pressure within the eye. All glaucoma disorders are characterized by vision loss caused by damage to the optic nerve. The optic nerve provides the pathway from the eyeball to the brain. If a doctor discovers the disease at an earlier stage, and the patient follows directions carefully, more vision can be saved.

The Glaucoma Service at Mass. Eye and Ear was founded by Paul A. Chandler, MD, and W. Morton Grant, MD. Mass. Eye and Ear’s glaucoma specialists use the latest technology and equipment to diagnose and treat the disease which is a leading cause of blindness in Americans and which is the leading cause of blindness among African-Americans. In addition, our ongoing research investigations include identifying risk factors – such as genes that predispose individuals to this blinding eye disease, discovering methods for early disease detection, and exploring novel therapeutics.

The most common incisional surgeries performed by the Mass. Eye and Ear Glaucoma Service are trabeculectomy surgery and tube shunt surgery. Patient outcomes for these incisional surgeries are reported for procedures performed during the two-year period from July 2007 to June 2009.
Select Resources

- GDX Scanning Laser Polarimeter for retinal nerve fiber analysis (Zeiss)
- Stratus Optical Coherence Tomography Model 3000 (Zeiss)
- Spectral Domain Ophthalmic Imaging System (Bioptigen)
- 2 Humphrey Visual Field Analyzers (Zeiss)
- Frequency Doubling Technology (FDT) Visual Field Instrument (Zeiss)
- Goldman Visual Field Machine (Haag Streit)
- Visucam ProNM Fundus Camera (Zeiss)
- Contact Ascan (Sonomed)
- Trabectome (NeoMedix)
- Endocyphotocoagulation (EndoOptiks)
- Canaloplasty (iScience Interventional)
- Laser Blood Flowmeter (Canon)
- Dynamic Contour Tonometry (Ziemer)
Glaucoma Surgery: Distribution of surgery types

July 2007 to June 2009

Two of the most common laser procedures required by glaucoma patients are laser peripheral iridotomy and laser trabeculoplasty. The following table includes both argon laser trabeculoplasty (ALT) and selective laser trabeculoplasty (SLT).

Mass. Eye and Ear’s Glaucoma Service can perform a wide range of laser and surgical procedures.
Glaucoma implant surgeries require the insertion of an implant or artificial tubing to lower the eye pressure. The two most common glaucoma implant devices used in the United States are the Ahmed Glaucoma Valve and the Baerveldt Glaucoma Implant. Trabeculectomy surgery is the gold standard incisional surgery that is usually performed first in patients who require glaucoma surgery. Trabectome surgery is a form of minimally invasive glaucoma surgery.

<table>
<thead>
<tr>
<th>Procedure Type</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser Peripheral Iridotomy</td>
<td>291</td>
<td>28.2%</td>
</tr>
<tr>
<td>Laser Trabeculoplasty</td>
<td>288</td>
<td>27.9%</td>
</tr>
<tr>
<td>Glaucoma Implant</td>
<td>164</td>
<td>15.9%</td>
</tr>
<tr>
<td>Combined Surgeries</td>
<td>120</td>
<td>11.6%</td>
</tr>
<tr>
<td>Trabeculectomy (no previous scarring)</td>
<td>80</td>
<td>7.7%</td>
</tr>
<tr>
<td>Revision of Glaucoma Implant</td>
<td>39</td>
<td>3.8%</td>
</tr>
<tr>
<td>Trabeculectomy (with previous scarring)</td>
<td>32</td>
<td>3.1%</td>
</tr>
<tr>
<td>Other (including Trabectome)</td>
<td>19</td>
<td>1.8%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,033</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
Mass. Eye and Ear’s glaucoma surgeons can perform almost all types of combined surgeries and have immediate access to in-house retina and cornea experts with whom s/he can collaborate.

Glaucoma procedures are most often performed with cataract surgery (phacoemulsification).

<table>
<thead>
<tr>
<th>SURGERY TYPE</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trabeculectomy and Phacoemulsification</td>
<td>54</td>
<td>45.0%</td>
</tr>
<tr>
<td>Trabectome and Phacoemulsification</td>
<td>25</td>
<td>20.8%</td>
</tr>
<tr>
<td>Other</td>
<td>16</td>
<td>13.3%</td>
</tr>
<tr>
<td>Glaucoma Implant and Phacoemulsification</td>
<td>12</td>
<td>10.0%</td>
</tr>
<tr>
<td>Glaucoma Implant and Pars Plana Vitrectomy</td>
<td>8</td>
<td>6.7%</td>
</tr>
<tr>
<td>Glaucoma Implant and Keratoprosthesis</td>
<td>5</td>
<td>4.2%</td>
</tr>
<tr>
<td>Total Combined Surgeries</td>
<td>120</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

To attain the best outcomes, glaucoma patients often need combined surgeries that require the added expertise of a retina or cornea specialist. The types of combined surgeries performed in the Glaucoma Service are detailed in the table below.
A total of 315 eyes had trabeculectomy surgery (with or without previous scarring) or glaucoma implant surgery (primary or revision) over a two-year period. The average intraocular pressure changes at 3 months are depicted for the 300 eyes that had sufficient follow-up data for analysis.

July 2007 to June 2009

Effects of Trabeculectomy and Glaucoma Implant Surgery on Eye Pressure

![Bar chart showing average intraocular pressure changes for trabeculectomy and glaucoma implant surgery]

The goal of glaucoma surgery is to lower intraocular pressure. Although the target or goal intraocular pressure varies per individual, normal eye pressures are in general from 10 mm Hg to 21 mm Hg.

The 300 eyes evaluated include:
- 79 trabeculectomies without scarring
- 32 trabeculectomies with previous scarring
- 155 primary tube surgeries
- 34 tube revisions

**N = 300**
A total of 315 eyes had trabeculectomy surgery (with or without previous scarring) or glaucoma implant surgery (primary or revision) over a two-year period. The vision changes at 3 months are depicted for the 296 eyes that had sufficient follow-up data for analysis.

The majority of patients having glaucoma surgery have stable vision after surgery.

Visual outcome from glaucoma surgery is usually considered successful when there is no further deterioration in vision three months after surgery.

Improved = more than 2 lines of improvement compared to pre-operative vision
No Significant Change = inclusive of 2 lines better or worse
Worsened = more than 2 lines worse

Benchmark: Visual outcomes for trabeculectomies and tubes at 1 year: 32% to 33% of patients with vision loss of 2 lines of vision or more.


The 296 eyes evaluated include:
- 79 trabeculectomies without previous scarring
- 32 trabeculectomies with previous scarring
- 152 primary tube surgeries
- 33 tube revisions

N = 296
Trabeculectomy and Glaucoma Implant Surgery: Intra-operative complications

July 2007 to June 2009

Of the 315 eyes that had trabeculectomy surgery (with or without previous scarring) or glaucoma implant surgery (primary or revision) over a two-year period, the intra-operative complications of the 308 eyes with sufficient follow-up data for analysis were recorded.

Over 97% of patients have no intra-operative complications from glaucoma surgery.

N = 308

- None 97.1%
- Hyphema 0.6%
- Vitreous Loss 0.6%
- Buttonholes 1.6%
- Scleral Flap Trauma = 0.0%
- Suprachoroidal Hemorrhage = 0.0%

The 308 eyes evaluated include:
- 78 trabeculectomies without scarring
- 32 trabeculectomies with previous scarring
- 159 primary tube surgeries
- 39 tube revisions
First video-rate spectral domain optical coherence tomography image of the eye

picture courtesy of Teresa C. Chen, MD and Johannes F. de Boer, PhD
The Cornea and Refractive Surgery Service is dedicated to providing the best and most scientifically advanced medical and surgical care to patients with corneal, ocular surface, and refractive disorders through excellence in patient care, research, and subspecialty training of young ophthalmologists. Our highly skilled surgeons utilize the latest technology and laser tools to offer the most advanced vision correction procedures.

For decades, our Cornea team has been at the forefront of many new medical and surgical advances in the field. New programs have been developed for patients with severe corneal scarring, including stem cell transplantation, ocular surface reconstruction, lamellar keratoplasty and keratoprosthesis (artificial cornea) surgery. The Cornea and Refractive Surgery Service also serves as a regional, national and international resource for the management of difficult-to-treat and sight-threatening diseases such as severe corneal ulcers, viral diseases, scarring diseases and severe cases of ocular surface disease (such as dry eye and neovascularization of the cornea) that have not responded to conventional therapies.
Select Resources

- Imaging Module IM 900 Video Photo Slit Lamp (Haag Streit)
- Heidelberg Retinal Tomograph with an anterior segment imaging module (Heidelberg)
- Confoscan 4 Confocal Microscope (Nidek)
- Ladarwave Custom Cornea Wave front System Aberrometer (Alcon)
- Cellchek SP-RU Noncontact Specular Microscope (Conan)
- Pentacam HR 3D Scheimpflug Camera (Oculus)
- Zywave Wave Front Analyzer/Aberrometer (Bausch & Lomb)
- Orbscan II Corneal Topographer (Bausch & Lomb)
- Ultrasonic Pachymeter (KMI Surgical Products)
- Contact Ascan (Sonomed)
- 30B Classic Pneumotonometer (Mentor)
- Topographer (Oculus)
- Smart System II 20/20 Wireless Remote Visual Acuity & Fixation System (M&S Technologies)
- 2 WaveLight Allegro Analyzers (Alcon)
- Spectral Domain Optical Coherence Tomography (Optovue)
A total of 450 surgeries were performed by Mass. Eye and Ear’s Cornea Service between July 2008 and June 2009. Of these 450 surgeries, 140 were penetrating keratoplasties (PK) and Descemets stripping endothelial keratoplasty (DSEK). Other surgeries included are (but not limited to): keratoprothesis surgery, deep anterior lamellar keratoplasty (DALK), and cataract surgery. Pictured below: Dr. James Chodosh
Cornea Surgery: Distribution of PK and DSEK surgeries

July 2008 to June 2009

Two of the most commonly performed surgeries by the Mass. Eye and Ear Cornea Service were penetrating keratoplasty (PK) and Descemets stripping endothelial keratoplasty (DSEK). Of these 140 surgeries, 90 percent (126/140) were PKs and 10 percent (14/140) were DSEK surgeries.

PK is a corneal transplant operation in which a diseased cornea, which is cloudy and opaque, is removed and replaced with a clear, cadaver cornea to restore vision.

In conditions where the cornea has minimal to no scarring, DSEK can be employed. In DSEK, the diseased Descemet’s membrane (or inner layer of the cornea) is removed and replaced by donor transplant tissue. This can be performed through a smaller incision, which may result in a more rapid rate of visual recovery.
Cornea Surgery: Visual acuity results of PK and DSEK surgeries at three months follow-up

July 2008 to June 2009

The goal of penetrating keratoplasty (PK) and Descemets stripping endothelial keratoplasty (DSEK) surgery is to improve vision. The 126 patients who had PK experienced an average improvement in visual acuity of 2.7 lines. The 14 patients who underwent DSEK experienced an average improvement of 3.3 lines.
Cornea Surgery: Clear corneal grafts for PK and DSEK at three months follow-up

*July 2008 to July 2009*

Over 96% of patients having either PK or DSEK surgery achieved surgical success.

The goal of penetrating keratoplasty (PK) and descemets stripping endothelial keratoplasty (DSEK) surgery is to achieve a clear cornea within three months of surgery.

Surgical Success Rates for PK and DSEK

<table>
<thead>
<tr>
<th>clear corneal grafts</th>
<th>PK</th>
<th>DSEK</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>N = 126</td>
<td>N = 14</td>
</tr>
<tr>
<td>80%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Keratoprosthesis Surgery
(The Boston Kpro)

pictures courtesy Joseph Ciolino, MD

"hand motions" vision pre-op

20/25 vision post-op
The Boston Keratoprosthesis (Kpro) is an artificial cornea developed at Mass. Eye and Ear by Claes Dohlman, MD, PhD. Dr. Dohlman is former Chief and Chair of the Department of Ophthalmology and currently Emeritus Professor of Ophthalmology at Harvard Medical School (HMS).

In development since the 1960s, the Kpro received FDA clearance in 1992. It is the most commonly used artificial cornea in the U.S. and the world with more than 3,000 implantations to date. The Kpro is reserved for patients blinded by cornea disease and for whom a standard corneal transplant is not a viable option.

The average vision pre-operatively was “hand motion” and the average vision after two years was 20/100. For the majority of patients, vision is limited by glaucoma and retinal diseases. This chart demonstrates that nearly three-quarters of the patients receiving a Boston K-Pro experienced vision improvement after two years.

Refractive surgery — commonly known as laser vision correction — is a term given to surgical procedures designed to correct certain vision problems such as myopia (nearsightedness), hyperopia (farsightedness) and astigmatism. These procedures use an excimer laser beam to help reshape the cornea. An excimer laser produces “cool” light beams which are ideal for refractive surgery, and these procedures are done on an outpatient basis. The two most common procedures performed with the excimer laser are photorefractive keratectomy (PRK) and laser in-situ keratomileusis (LASIK).

Select Resources

- Eye Q Allegretto Wave 400 Hertz Excimer Laser System (Alcon)
- Star S4 Excimer Laser System (VISX/AMO)
- Technolas Excimer Laser System (Bausch & Lomb)
- Intralase FS Femtosecond Laser System (AMO)
- VISX Wavescan Wave Front Aberrometer (AMO)
- Epivision Epitome (Gebauer)
- Conductive Keratoplasty System (Viewpoint)
- Hansatome Microkeratomes (Bausch & Lomb)
- 30B Classic Pneumotonometer (Mentor)
Some of the refractive procedures offered by the Refractive Surgery Service include:

- LASIK (laser-assisted in situ keratomileusis)
- PRK (photorefractive keratectomy)
- PTK (photo-therapeutic keratectomy)
- AK (astigmatic keratotomy)
- Intacs (intrastromal corneal ring segments)
- Visian ICL phakic intraocular lens

Cataract surgery with premium intraocular lenses (IOLs) are also offered for patients who want this option. Examples of these lenses include (but are not limited to):

- Acrysof Toric
- ReStor
- Tecnis multifocal
- Crystalens
Refractive Surgery

1. 

2. 

3. 

4.
Refractive Surgery
LASIK and PRK: Degree of refractive error and choice of refractive procedure

July 2008 to June 2009

The graph below shows the distribution of refractive errors treated by three different refractive procedures:

Epi-LASIK (laser-assisted in situ keratomileusis)
Intra-LASIK (laser-assisted in situ keratomileusis)
PRK (photorefractive keratectomy)

Refractive Error and Choice of Refractive Procedure

- Low Myopia
  less than 3 diopters of sphere,
  less than 1 diopter of astigmatism

- Moderate Myopia
  3 to 7 diopters of sphere,
  less than 1 diopter of astigmatism

- High Myopia
  7 to 10 diopters of sphere,
  less than 1 diopter of astigmatism

- Hyperopia
  0 to 5 diopters of sphere

Of the 46 patients that had Epi-LASIK, 31 had low myopia and 15 had moderate myopia. Of the 283 patients treated with Intra-LASIK, 150 patients had moderate myopia and 77 had low myopia. Of the 11 patients that had PRK, eight had low myopia and three had hyperopia.
Of the 329 eyes that had LASIK (laser-assisted in situ keratomileusis) surgery during the one-year study period, 86.6 percent (285/329) achieved a post-operative refraction within 0.5 diopters of their target refraction. Of the 11 eyes that had PRK (photorefractive keratectomy), 54.5 percent (6/11) achieved a post-operative refraction within 0.5 diopters of their target refraction.

These are results at one month follow-up after LASIK for myopia, three months follow-up after LASIK for hyperopia, and three months follow-up after PRK.
Of the 329 eyes that had LASIK (laser-assisted in situ keratomileusis) during the one-year study period, only 1.2 percent (4/329) had an enhancement/retreatment procedure within three months. Of the 11 eyes that had PRK (photorefractive keratectomy) surgery, none required an enhancement/retreatment procedure within three months.

**Enhancement/Retreatment Rates:**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>LASIK (4 of 329 eyes):</td>
<td>1.2%</td>
</tr>
<tr>
<td>PRK (0 of 11 eyes):</td>
<td>0%</td>
</tr>
</tbody>
</table>

N = 329
Dr. Roberto Pineda performing laser vision correction surgery on a patient.
Refractive Surgery
LASIK: Intra-operative complications

July 2008 to June 2009

Of the 329 eyes that had LASIK (laser-assisted in situ keratomileusis) surgery during the one-year study period, only one case had a suction break (0.3 percent). Similarly, only one case had a vertical bubble break. The final refractive error for both cases was within 0.5 diopters of the target refraction.

LASIK INTRA-OPERATIVE COMPLICATION RATES:

<table>
<thead>
<tr>
<th>Complication</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>suction break (1 of 329 eyes):</td>
<td>0.3%</td>
</tr>
<tr>
<td>vertical bubble break (1 of 329 eyes):</td>
<td>0.3%</td>
</tr>
<tr>
<td>aborted IntraLase or converted (0 of 329 eyes):</td>
<td>0%</td>
</tr>
<tr>
<td>major flap holes or tears (0 of 329 eyes):</td>
<td>0%</td>
</tr>
<tr>
<td>microkeratome complication (0 of 329 eyes):</td>
<td>0%</td>
</tr>
</tbody>
</table>

N = 329
Of the 329 eyes that had LASIK (laser-assisted in situ keratomileusis) surgery during the one-year study period, only two eyes developed deep lamellar keratitis (DLK). Six eyes had flap wrinkles, and three eyes developed severe dry eye symptoms.

<table>
<thead>
<tr>
<th>LASIK POST-OPERATIVE COMPLICATION RATES:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DLK (2 of 329 eyes):</td>
<td>0.6%</td>
</tr>
<tr>
<td>infectious keratitis (0 of 329 eyes):</td>
<td>0%</td>
</tr>
<tr>
<td>flap wrinkle or slippage in week 1 (6 of 329 eyes):</td>
<td>1.8%</td>
</tr>
<tr>
<td>epithelial ingrowth (0 of 329 eyes):</td>
<td>0%</td>
</tr>
<tr>
<td>loss of 2 lines or more best uncorrected vision (0 of 329 eyes):</td>
<td>0%</td>
</tr>
<tr>
<td>severe persistent dry eye (3 of 329 eyes):</td>
<td>0.9%</td>
</tr>
</tbody>
</table>

N = 329
Refractive Surgery
PRK: post-operative complications at three months follow-up

July 2008 to June 2009

Of the 11 eyes that had PRK (photorefractive keratectomy) surgery during the one-year study period, only two patients (18.2 percent) suffered from severe dry eye symptoms at last follow-up.

PRK POST-OPERATIVE COMPLICATION RATES:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>retreatment/enhancement (0 of 11 eyes):</td>
<td>0%</td>
</tr>
<tr>
<td>haze greater than 1+ (0 of 11 eyes):</td>
<td>0%</td>
</tr>
<tr>
<td>loss of 2 lines or more best uncorrected vision (0 of 11 eyes):</td>
<td>0%</td>
</tr>
<tr>
<td>severe persistent dry eye (2 of 11 eyes):</td>
<td>18.2%</td>
</tr>
</tbody>
</table>

N = 11
Ophthalmic plastic and orbital surgery is a unique and highly specialized discipline that combines a surgeon’s technical expertise with his or her artistic skill and ability. The Ophthalmic Plastic and Reconstructive Surgery Service at Mass. Eye and Ear focuses on functional disorders of the eyelids, orbits, and lacrimal drainage system. Our Service also provides cosmetic enhancement of the eye zone (eyes, lids, upper cheeks, brow and forehead) to enhance a patient’s appearance and self-esteem.

Mass. Eye and Ear’s Ophthalmic Plastic and Reconstructive surgeons are board-certified and highly skilled at performing a host of delicate aesthetic and reconstructive procedures in and around the eye structure, utilizing the latest technologies. Our expertise includes reconstructive and cosmetic eyelid surgery, laser surgery, treatment of orbital tumors and inflammations (such as thyroid eye disease), removal of eyes (enucleation), and treatment for traumatic lacerations and fractures.

**Select Services**

- Laser dacryocystorhinostomy (DCR)
- Advanced treatment of vascular anomalies
- Official support group with the National Graves’ Disease Foundation
The Lacrimal System
Oculoplastic Surgery: Distribution of surgery types

March 2008 to March 2009

There were 632 surgeries performed by Mass. Eye and Ear's Oculoplastic Service during a one-year period. Orbital cases primarily involved fractures or tumors and comprised 27.8 percent (176/632) of cases.

Surgery Types

- Lid Cases 54.3%
- Lacrimal Cases 17.7%
- Orbit Cases 27.8%

N = 632
This bar graph demonstrates that the incidence of post-operative infections following surgeries performed by the Mass. Eye and Ear Oculoplastic Service is rare. Only one of 632 (0.16 percent) patients developed MRSA (Methicillin resistant Staph aureus) cellulitis following resection of an orbital tumor. The infection was successfully treated without permanent ocular sequelae.
Oculoplastic Surgery:
Lid surgeries re-operation rate at six months follow-up

March 2008 to February 2009

Of the 343 eyes that had eyelid surgery, only 2.9 percent (10/343) of the eyes required a second procedure within six months in order to achieve surgical success.
Founded in 1977, the Retina Service at Mass. Eye and Ear is one of the largest subspecialty groups of its kind in the country. The Service takes pride in a rich and renowned history of innovation and is recognized around the world for its major scientific and clinical contributions to vision science. Always on a path to discovery, our retina specialists are leaders in their field with subspecialty expertise that spans virtually all medical and surgical eye diseases affecting the vitreous, macula and retina.

We offer adults and children access to the most current treatment modalities and leverage state-of-the-art technology to provide the most comprehensive, clinical care available anywhere in the world. Our physician-scientists are highly skilled at diagnosing and treating a full range of ocular diseases, including macular degeneration, diabetic retinopathy, retinal detachments and ocular tumors. In addition to offering the most effective therapies available, we are engaged in clinical trials that give our patients the opportunity to participate in — and often benefit from — groundbreaking, sight-saving research.
Select Resources

- Diagnostic Ultrasound System I-3 System ABD (Ellex) – for UBM, diagnostic Bscan, diagnostic axial length, and biometry A-scan
- Cirrus HD-OCT Model 4000 (Zeiss)
- Spectralis HRA and OCT/Fluorescein & ICG testing (Heidelberg)
- Heidelberg Retina Angiograph II/fluorescein, ICG & red free photos (Heidelberg)
- Panretinal angle contact lens retinal camera Model 1000 (Optomedica)
- 20 to 50 degree retinal camera Model TRC-IX (Topcon)
- Photo slit-lamp model SL-D7 (Topcon)
- Retcam 11 contact lens camera (Clarity)
- Visio Electro Diagnostic ERG machine (LKC Technologies Inc)
- Confoscan 4, Model CS4115 (Nidek)
- Stratus Optical Coherence Tomography Model 3000 (Zeiss)
Retinal Detachment
Retinal Detachment Repair

scleral buckle
Excluding lasers and intravitreal injections, 420 major surgeries were performed by the Mass. Eye and Ear Retina Service during a one-year period. Of these operations, we reviewed the outcomes of 364 patients who had six months of follow-up data. All results are described at the six month visit.

Dr. Shizuo Mukai exits the OR after surgery.
Retina Surgery:
Distribution of indications for major retina surgeries

March 2008 to February 2009

Group A: Primary rhegmatogenous retinal detachment
Group B: Diabetic retinopathy (with macular edema) and diabetic vitreous hemorrhage
Group C: Epiretinal membrane
Group D: Complicated rhegmatogenous retinal detachment and giant retinal tear
Group E: Macular hole
Group F: Complicated diabetic retinopathy (with fibrovascular proliferation and/or retinal detachment)
Group G: Repair of cataract complications/dropped lens

N = 364
Retina Surgery: 
All retina surgeries combined, vision improvement at six months follow-up

March 2008 to February 2009

Visual improvement is defined as an improvement of vision by at least two lines. Of the 364 major operations that were analyzed, 50.8 percent (185/364) had at least two lines of vision improvement at the six month follow-up visit.

The following charts display visual improvements and complication rates for the major retina surgeries.
Retina Surgery: Surgery for diabetic retinopathy, vision improvement at six months follow-up

March 2008 to February 2009

Visual improvement is defined as an improvement of vision by at least two lines.

The visual outcomes of the 82 eyes that had surgery for diabetes-related problems are shown below:

- **Group A (67 eyes):** Diabetic retinopathy (with macular edema) and diabetic vitreous hemorrhage
- **Group B (15 eyes):** Complicated diabetic retinopathy (with fibrovascular proliferation and/or retinal detachment)

$N = 82$
Retina Surgery: Surgery for rhegmatogenous retinal detachment, vision improvement at six months follow-up

March 2008 to February 2009

Visual improvement is defined as an improvement of vision by at least two lines.

The visual outcomes of the 199 eyes that had surgery for rhegmatogenous retinal detachment (both macula-on and macula-off) are shown below:

Group A: Primary rhegmatogenous retinal detachment

Group B: Complicated rhegmatogenous retinal detachment and giant retinal tear

\[ N = 199 \]
Retina Surgery: Macula surgery, vision improvement at six months follow-up

March 2008 to February 2009

Visual improvement is defined as an improvement of vision by at least two lines.

Shown below are the visual outcomes of the 21 eyes that had macular hole surgery and the 51 eyes that had epiretinal membrane peel.

\[
\begin{align*}
N &= 21 \\
N &= 51
\end{align*}
\]
Dr. Ivana Kim speaks to a community group about age-related macular degeneration.
Retina Surgery: Intra-operative complications for all 364 major operations

March 2008 to February 2009

The following graph represents the intra-operative complications that occurred for the 364 major operations that were done by the Mass. Eye and Ear Retina Service. The following intra-operative complications were recorded:

- iatrogenic macula break
- iatrogenic optic nerve damage
- choroidal hemorrhage
- traumatic cataract

Only one case (for primary rhegmatogenous retinal detachment repair) developed an intra-operative complication, choroidal hemorrhage.

N = 364
## Retina Surgery: Post-operative complications for all retinal surgeries (Groups A-G) at six months follow-up

*March 2008 to February 2009*

<table>
<thead>
<tr>
<th>Complication</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infection (1 of 364 eyes):</td>
<td>0.3%</td>
</tr>
<tr>
<td>Retinal detachment (15 of 364 eyes):</td>
<td>4.1%</td>
</tr>
<tr>
<td>Choroidal hemorrhage (0 of 364 eyes):</td>
<td>0%</td>
</tr>
<tr>
<td>Proliferative vitreoretinopathy (PVR) (17 of 364 eyes):</td>
<td>4.7%</td>
</tr>
<tr>
<td>Persistent intraocular pressure greater than 30 mmHg (glaucoma) (0 of 364 eyes):</td>
<td>0%</td>
</tr>
<tr>
<td>Hypotony (0 of 364 eyes):</td>
<td>0%</td>
</tr>
<tr>
<td>New retinal breaks (iatrogenic) (3 of 364 eyes):</td>
<td>0.8%</td>
</tr>
<tr>
<td>Persistent corneal epitheliopathy/other corneal pathology (2 of 364 eyes):</td>
<td>0.5%</td>
</tr>
<tr>
<td>Vitreous hemorrhage (29 of 364 eyes):</td>
<td>8.0%</td>
</tr>
<tr>
<td>Development/recurrence of macular pucker or epiretinal membrane (50 of 364 eyes):</td>
<td>13.7%</td>
</tr>
<tr>
<td>Silicone oil emulsification (1 of 364 eyes):</td>
<td>0.3%</td>
</tr>
<tr>
<td>Macular hole (3 of 364 eyes):</td>
<td>0.8%</td>
</tr>
<tr>
<td>Visually significant cataract (15 of 364 eyes):</td>
<td>4.1%</td>
</tr>
</tbody>
</table>

The information below represents the post-operative complications that occurred for the 364 retinal surgeries that were performed by the Mass. Eye and Ear Retina Service and that had six months of follow-up data.
For all groups, the most common post-operative complication was development or recurrence of an epiretinal membrane: 13.7 percent (50/364) of patients.

The second most common complication was vitreous hemorrhage: 8.0 percent (29/364) of patients. Of the patients who developed a post-operative vitreous hemorrhage (VH), 82.7 percent (24/29) were diabetics. Of the 24 patients who developed a post-operative VH, 17 were from group B (diabetic retinopathy, diabetic vitreous hemorrhage) and seven were from group F (complicated diabetic retinopathy).

Proliferative vitreoretinopathy (PVR) developed in 4.7 percent (17/364) of patients. All 17 eyes with this complication were having surgery for rhegmatogenous retinal detachment.

Nine of these patients (52.9 percent) were from group D (complicated rhegmatogenous retinal detachment). The remaining eight (47.1 percent) were from group A (primary rhegmatogenous retinal detachment).

A visually significant cataract developed in 4.1 percent (15/364) of patients, such that subsequent cataract surgery was performed. However, this is not necessarily considered a surgical complication resulting from surgeon error since cataract development is a well known side effect of retinal surgeries in general.

Infection developed in 0.3 percent (1/364) of patients.

Group A: Primary rhegmatogenous retinal detachment

Group B: Diabetic retinopathy (with macular edema) and diabetic vitreous hemorrhage

Group C: Epiretinal membrane

Group D: Complicated rhegmatogenous retinal detachment and giant retinal tear

Group E: Macular hole

Group F: Complicated diabetic retinopathy (with fibrovascular proliferation and/or retinal detachment)

Group G: Repair of cataract complications/ dropped lens
Primary rhegmatogenous retinal detachment (RD) was the most common retinal condition (43.9 percent or 160/364) that occurred in patients treated by the Mass. Eye and Ear Retina Service.

This pie chart demonstrates the initial surgical procedure performed for primary rhegmatogenous RD.
Primary rhegmatogenous retinal detachment was the most common retinal condition (43.9 percent or 160/364) that occurred in patients treated by the Mass. Eye and Ear Retina Service.

Over 95% of rhegmatogenous retinal detachment patients achieved surgical success.

The Mass. Eye and Ear retina surgeons were successful in reattaching the retina in 95.6% (153/160) of cases using one or more procedures, which may have included pars plana vitrectomy, scleral buckle surgery, and/or pneumatic retinopexy.

Retina Surgery: Final retinal reattachment rate at six months for primary rhegmatogenous retinal detachment

March 2008 to February 2009

N = 160
Dr. Lucy Young examines a patient’s retina during surgery.
Retina Surgery: Retinopexy; distribution of prophylactic treatment types

January 2008 to February 2009

This pie chart depicts the 77 eyes that were treated for retinal tears or breaks in order to prevent retinal detachment. Sixty-six percent of eyes (51/77) were treated with laser prophylaxis, and 34 percent of eyes (26/77) were treated with cryotherapy prophylaxis.
Retina Surgery: Retinopexy; success rates at six months for prevention of retinal detachment (RD)

January 2008 to February 2009

Of the 71 eyes with six months of follow-up data, cryotherapy (CRYO) achieved a 96 percent success rate (25/26 eyes), and laser treatment achieved a 90 percent success rate (46/51 eyes).

Success Rates for RD Prevention

N = 71
Retina Surgery: Intravitreal injections infection rate

July 2006 to June 2009

Complete success is defined as a zero percent infection rate per year. Benchmark for intravitreal infection rates is 0.02% to 1.9%.

Mass. Eye and Ear intravitreal injection infection rate over three years: 0.039%

In order to identify cases of acute endophthalmitis, a retrospective review was performed of all consecutive eyes that underwent intravitreal injections from July 1, 2006 to June 30, 2009. During the 36-month study interval, 5,067 intravitreal injections were performed.

The overall incidence rate of endophthalmitis subsequent to intravitreal injection was 0.039% (two of 5,067 eyes). In one case of acute endophthalmitis, the patient presented three days after the injection. Bacterial cultures revealed coagulase-negative Staphylococcus species. Treatment of the infection resulted in a best corrected visual acuity at 19 month follow-up of 20/25 (baseline 20/30). In the second case, the patient presented four days after injection. Gram stain showed moderate bacteria but cultures were negative. After treatment, best corrected visual acuity at two years follow up was 20/50 -1 (baseline 20/32-2).

In conclusion, acute endophthalmitis is a rare potential complication of intravitreal injections.


N = 5,067
Adverse drug reactions to fluorescein angiography (FA) and indocyanine green (ING) tests are described below.

### Retina Testing: FA and ICG

**Adverse drug reactions**

*October 2008 to September 2009*

<table>
<thead>
<tr>
<th>Test</th>
<th>Number of Tests Performed</th>
<th>Adverse Reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>FA</td>
<td>1,605</td>
<td>16</td>
</tr>
<tr>
<td>ICG</td>
<td>109</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reaction Reported</th>
<th># of Patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>itching and hives</td>
<td>8</td>
<td>50</td>
</tr>
<tr>
<td>itching</td>
<td>6</td>
<td>37.5</td>
</tr>
<tr>
<td>burning sensation in arm, dizziness, nausea</td>
<td>1</td>
<td>6.25</td>
</tr>
<tr>
<td>chills and muscle/back aches</td>
<td>1</td>
<td>6.25</td>
</tr>
</tbody>
</table>
Lois Hart performing an optical coherence tomography scan of a patient’s retina.
Tumors can arise in almost any part of the eye. Some eye tumors can be quite serious, while others require no treatment. Ophthalmologists at Mass. Eye and Ear are highly experienced at treating many different types of eye tumors. Some of the specialty areas that we have developed include:

**Ocular Surface Tumors**
Tumors may occur on the surface of the eye due to overexposure to the sun and other causes.

**Orbital Tumors and Inflammation**
The orbit is comprised of the bones of the eye socket, the eyeball, the eye muscles, the optic nerve, and the surrounding fat. Any of these structures may form a tumor in adults and children.

**Retinoblastoma**
Tumors of the retina, in the back of the eye, are uncommon and are mostly found in young children, although they can develop at any age.

**Uveal Melanoma**
Melanoma of the uveal tract is the most common intraocular primary tumor and is a serious condition that requires careful diagnosis and follow-up. The data that follow focus on the treatment of this form of ocular cancer.
Tumors located within the eye can be challenging to diagnose and treat effectively without causing damage to the eye and loss of vision. The Mass. Eye and Ear’s Ophthalmic Oncology Service, under the direction of Evangelos Gragoudas, MD, is a national and international referral center for the diagnosis and treatment of eye neoplasms. Proton beam irradiation was developed at Mass. Eye and Ear in conjunction with scientists at Harvard’s High Energy Physics Department and a team of radiotherapists from Massachusetts General Hospital. In 1975, the first proton beam irradiation treatment was administered at Mass. Eye and Ear to a patient with intraocular malignant melanoma. Since then, more than 3,000 patients with eye melanoma have been treated according to established standardized protocols for evaluation, treatment, and follow-up. Today, proton beam irradiation is one of the most common and effective therapies for treating intraocular tumors without causing additional vision loss. Mass. Eye and Ear’s physician-scientists direct their on-going research efforts toward novel methods of diagnosis and additional therapeutic approaches.

The Uveal Melanoma Registry, a population-based registry for ocular melanomas, was established at Mass. Eye and Ear in the early 1980s. The registry contains detailed demographic, clinical and therapeutic data on most patients who have been treated by proton beam irradiation. A serum, plasma and DNA archive was added to the registry in the mid-nineties and houses specimens from more than 1,600-plus patients with uveal melanoma. This information is used as a resource for biomarker and genetic research and has enabled Mass. Eye and Ear researchers to conduct several studies of cancer susceptibility genes and biomarkers.
Photos courtesy Evangelos S. Gragoudas, MD

Proton Beam Irradiation: Cumulative rates of local recurrence of malignant melanoma following irradiation

35 years of experience, 3,000+ patients

Long-term follow-up after radiation therapy revealed 60 cases of recurrence (2.9%), of which 45 cases were documented and 15 cases were suspect. The earliest time of recurrence was 5.2 months and the latest 10.5 years. Registry data includes follow-up periods that are well over 10 years.

Proton beam irradiation is the most successful radiotherapeutic modality with local control of 97% of treated cases.

Survival rates after diagnosis of metastasis are poor at 20 percent at one year and six percent at two years. Of the 2069 patients evaluated in this study, 408 (about 20 percent) died (range: three months to 16 years post-therapy).

Cumulative Mortality Rates of Metastatic Melanoma

<table>
<thead>
<tr>
<th>Year Post-Rx</th>
<th>All Causes</th>
<th>Metastatic Melanoma</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>21%</td>
<td>14%</td>
</tr>
<tr>
<td>10</td>
<td>36%</td>
<td>23%</td>
</tr>
<tr>
<td>15</td>
<td>48%</td>
<td>27%</td>
</tr>
</tbody>
</table>

“All causes” of death (column 2) in the melanoma patients include accidents, heart attacks, strokes, etc. “Metastatic melanoma” death rate (column 3) refers to the percentage of patients that died from uveal melanoma metastases. Liver metastases were noted in 89 percent of the 408 patients. Registry data includes follow-up periods that are well over 10 years.

Proton Beam Irradiation: Cumulative rates of vision loss after irradiation of malignant melanoma

35 years of experience, 3,000+ patients

Vision loss (exceeding 20/200) can occur over time. This table shows the percentage of patients who had best corrected visual acuity (BCVA) of 20/100 or better over time. Fourteen percent of patients presented with visual acuity worse than 20/100 in the affected eye.

### Cumulative Rates of Vision Loss After Irradiation of Malignant Melanoma

<table>
<thead>
<tr>
<th>YEAR POST-RX</th>
<th>PERCENT</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>52%</td>
<td>50-55</td>
</tr>
<tr>
<td>10</td>
<td>65%</td>
<td>62-68</td>
</tr>
<tr>
<td>15</td>
<td>71%</td>
<td>66-75</td>
</tr>
</tbody>
</table>

Poor vision was associated with retinal detachment or tumor encroaching on the macula or disc. Eighty-eight percent of patients had visual deterioration to hand motions (HM) or worse by 10 years post-therapy. Registry data includes follow-up periods that are well over 10 years.

Proton Beam Irradiation: Summary of results; proton beam irradiation for malignant melanoma

Results from the Uveal Melanoma Registry

35 years of experience, 3,000+ patients

- 4.2% of patients experienced tumor re-growth at 10 years post-irradiation
- 23% of patients died from metastasis at 10 years post-irradiation
- 34% of patients retained visual acuity of 20/200 or better at 10 years post-irradiation
- <10% of patients underwent enucleation
Dr. Lucy Young examines a patient.
Retinal Degenerations/
Electroretinography
(ERG) Service
The Electroretinography (ERG) Service performs evaluations of patients with retinal disease who are referred for diagnosis, prognosis, genetic counseling, and treatment. Approximately 50% of the patients evaluated in the Service have retinitis pigmentosa and are being treated with vitamin A palmitate 15,000 IU/day and an oily fish diet. Many others have allied night blinding disorders or juvenile hereditary macular degeneration.

Approximately 800 patients are seen per year. The Service provides specialized measures of retinal function and performs, on average, 4,200 tests per year including full-field and focal ERGs as well as measures of dark adaptation threshold, color vision, and letter recognition macular perimetry. The macula is also evaluated with optical coherence tomography (OCT) in selected cases. Because the majority of patients with retinitis pigmentosa have non-detectable ERGs with conventional testing by young adulthood, the Service uses computer averaging with narrow band-pass filtering, which has extended the range of detectability of cone ERGs almost 100-fold, thereby, making it possible to follow the disease through almost its entire course. A cone ERG actuarial table derived from 6,500 patient visits over the past 35 years is used to estimate long-term visual prognoses for patients with typical retinitis pigmentosa. Where applicable, visual aids are prescribed, including the ITT Night Vision pocketscope, which allows night-blind patients to achieve their best daylight vision under conditions of dim illumination.
The Service provides training to residents, fellow, and medical students in the use of specialized measures of retinal function in the assessment of retinal disease.

Select Resources

- Full field electroretinogram (ERG)
- Focal ERG
- Ishihara color plates
- Farnsworth D-15 Color Test
- Farnsworth Munsell 100-Hue Color Test
- Blue Cone Monochromat Color Plates
- 2 Humphrey Field Analyzers (Zeiss)
- Letter Recognition Macular Perimetry Test
- Stratus Optical Coherence Tomography Model 3000 (Zeiss)
- CR6-45NM non-mydriatic retinal camera (Canon)
- Goldmann-Weekers Dark Adaptometer (Haag-Streit)
- 2 Goldmann Visual Field Perimeters (Goldmann)
- 2 Potential Acuity Meters (Mentor)
Retinal Degenerations/ Electroretinography (ERG) Service: Electroretinogram testing

*October 2008 to September 2009*

The ERG is a light-evoked response recorded with a specialized contact lens that provides a measure of the electrical activity of the retina. The amplitude of the ERG is related to the number of remaining photoreceptors.

| Number of ERG Service outpatient visits: | 886 |
| Number of ERGS (ERG and Retina Service) | 898 |
| Number of associated additional procedures: | 3,569 |
Electroretinogram (ERG) Testing
Rate of decline of ERG function for patients with typical retinitis pigmentosa

The illustrated curve, based on cone ERG amplitudes recorded from 1,039 patients followed for three to 29 years, shows that an exponential function sufficiently describes the rate of decline among patients representing all genetic types combined.

30Hz Cone ERG Amplitude (µV) by Age
for Patients with Retinitis Pigmentosa

1039 Patients (Ages 2-71 years at first visit)
6,553 Visits (3-29 years of follow-up)
baseline 30Hz cone ERG ≥ 0.68 μV

dominant 26%
recessive 19%
X-linked 8%
isolate 38%
undetermined 9%


N = 6,553 patient visits
Evidence has been obtained that the half time for loss of remaining cone ERG amplitude (as a measure of retinal degeneration) is, on average, about seven years without treatment and 8.5 years with vitamin A treatment for patients with typical retinitis pigmentosa. Patients who wish to have an estimate of their long-term visual prognosis come to the ERG Service at Mass. Eye and Ear for computerized cone ERG testing, preferably for three or four visits at two-year intervals to quantitate their rate of decline. The cone ERG actuarial table below illustrates the estimated number of additional years to decline to 0.05 µV (i.e. time to reach virtual blindness, that is, inability to walk out of a well-lighted room without assistance) without treatment (middle column) or with vitamin A treatment (right column).

**Electroretinogram (ERG) Testing**

Cone ERG actuarial table for patients with retinitis pigmentosa to estimate average long-term visual prognoses based on 30-Hz cone ERG amplitude at a single visit.

*Table legend: Expected # of years for a patient with a given 30-Hz cone ERG at the initial visit to decline to 0.05µV.*

<table>
<thead>
<tr>
<th>30-Hz ERG (µV) (Initial Visit)</th>
<th>No Treatment (10% Loss Per Year)</th>
<th>Vitamin A (8.3% Loss Per Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>6.58</td>
<td>8.00</td>
</tr>
<tr>
<td>0.50</td>
<td>21.85</td>
<td>26.57</td>
</tr>
<tr>
<td>1.00</td>
<td>28.43</td>
<td>34.57</td>
</tr>
<tr>
<td>2.00</td>
<td>35.01</td>
<td>42.57</td>
</tr>
<tr>
<td>2.50</td>
<td>37.13</td>
<td>45.15</td>
</tr>
<tr>
<td>3.50</td>
<td>40.32</td>
<td>49.03</td>
</tr>
<tr>
<td>5.00</td>
<td>43.71</td>
<td>53.15</td>
</tr>
<tr>
<td>8.00</td>
<td>48.17</td>
<td>58.57</td>
</tr>
<tr>
<td>10.00</td>
<td>50.29</td>
<td>61.15</td>
</tr>
</tbody>
</table>

*N = 6,553 patient visits*
**Example:** With no treatment, a patient aged 32 with 2.0 µV at the initial visit would be expected, on average, to reach 0.05 µV in 35 years and retain useful vision until age 67 (i.e. 32 + 35). With vitamin A treatment, this patient would be expected, on average, to reach 0.05 µV in 42.5 years and retain useful vision until age 74.5 (i.e. 32 + 42.5).

Because the majority of patients with retinitis pigmentosa have non-detectable ERGs with conventional testing (i.e. <10 µV, lower norm = 50 µV) by young adulthood, the Service uses computer averaging with narrow band-pass filtering, which has extended the range of detectability of cone ERGs almost 100-fold, thereby, making it possible to follow the disease through almost its entire course.

One of our patients had been told she would be blind by age 35 and should learn Braille. With computer averaging and narrow band filtering, she had easily detectable ERGs large enough to estimate that she would retain useful vision into later life. She has returned for several visits that have confirmed that her rate of decline conforms with the prediction in the cone ERG actuarial table.

The Pediatric Ophthalmology and Strabismus Service is a formal partnership of the Mass. Eye and Ear and the Children’s Hospital Ophthalmology Foundation (CHOF). Established in August 2009, CHOF at Mass. Eye and Ear is one of the most comprehensive pediatric ophthalmology networks in the country. Combining our pediatric forces has expanded the depth and breath of services to our patients and enabled a more integrated experience for faculty, fellows and students.

The Service provides comprehensive, primary care for the diagnosis and management of infant and child vision and common childhood vision disorders. Pediatric eye care comprises a wide range of evaluations and treatments for our patients, from screening for normal vision to caring for complex eye conditions. Our physicians treat a full range of eye disorders and diseases. Some of the more common disorders include nearsightedness, farsightedness, amblyopia (lazy eye), and childhood and adult strabismus (crossed eyes). Our pediatric experts also perform surgery to correct ocular misalignment and double vision.
Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exercitation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat.

esotropia  

resection surgery  

muscle advanced  

part of muscle resected  

extropia  

recession surgery  

muscle recessed  

after
The Pediatric Ophthalmology and Strabismus Service performed 100 strabismus surgeries during a one-year period. The following data represents 67 of these patients who had a follow-up of at least four to six weeks.

- Number of pediatric strabismus cases = 17 cases
- Number of adult strabismus cases = 50 cases

This graph above shows the distribution of strabismus cases according to diagnosis. Exotropia (27/67 cases) and esotropia (24/67 cases) were the most common diagnoses. Together, they represent 76.1 percent (51/67) of the total cases evaluated.
One hundred strabismus surgeries were performed by the Pediatric Ophthalmology and Adult Strabismus Service during a one-year period. Of the 67 strabismus surgery patients who had sufficient follow-up, 74 percent (50/67) were adults and 26 percent (17/67) were children.

N = 67
Strabismus Surgery: Surgical success rates

July 2008 to June 2009

One hundred strabismus surgeries were performed by the Pediatric Ophthalmology and Adult Strabismus Service during a one-year period. The surgical success rates of the 67 strabismus surgery patients who had sufficient follow-up data are described below.

Over 80% of patients having strabismus surgery achieved good ocular alignment.

Final pediatric outcome (at four to six weeks)
- Good: Constant deviation <10 prism diopters in primary position and/or anomalous head position resolved
- Poor: Over- or under-corrected

Final adult outcome (at four to six weeks)
- Good: Diplopia disappeared and/or anomalous head position resolved and/or constant deviation <10 prism diopters in primary position
- Poor: Over- or under-corrected

Of the 67 patients that were reviewed, 83.6 percent (56/67) had good outcomes.

N = 67
Emergency and Trauma Eye Care
Mass. Eye and Ear’s 24-hour, 7 days-a-week, dedicated eye Emergency Department is the only specialized facility of its kind in New England. The hospital is a major referral center for eye trauma throughout New England and provides other emergency assistance to patients whose regular ophthalmic provider is not readily available. We provide care for many different types of urgent and emergent eye problems on a walk-in basis. The operating rooms at Mass. Eye and Ear are always available for urgent surgical cases. Our expert staff has decades of experience in treating emergent ophthalmic conditions and handles some 12,000 patient visits yearly. A strong partnership with Massachusetts General Hospital (MGH) enables reciprocal medical and surgical support at both facilities.

The Eye Trauma Service at the Mass. Eye and Ear cares for adults and children with severe eye injuries. The Service accepts patient referrals from emergency rooms, health-care facilities and private practices from all over New England. Our highly experienced clinicians provide surgical and inpatient care for open-globe injuries, as well as outpatient management and follow-up for patients with any significant eye trauma. Eye Trauma service staff also provides ocular trauma coverage for both MGH and the Brigham and Women’s Hospital. As always, ophthalmology experts from within the hospital are a ready resource if subspecialty services are needed. Eye Trauma staff work closely with subspecialists in Oculoplastics, Cornea, Glaucoma, Retina, Uveitis, Neuro-Ophthalmology, Pediatrics, Strabismus and Vision Rehabilitation to successfully manage patients with complex cases. In addition to patient care, the Eye Trauma Service is actively involved in preventative strategies and clinical research related to ocular trauma.
Emergency Department: Ophthalmology emergency visits

October 2008 to September 2009

This bar graph shows the number of ophthalmology patients seen monthly by the Emergency Department during a one-year period. The number of patients generally increased during the summertime. The average number of patients seen each month was 1,020.

N = 12,239
Emergency Department: Ophthalmology emergency consults at MGH

October 2008 to September 2009

349: number of emergency consults that were at Massachusetts General Hospital and that were performed by Mass. Eye and Ear ophthalmologists, who staff the 24-7 Emergency Department.
The average wait time to see a Mass. Eye and Ear Emergency Department ophthalmologist was 2.3 hours. According to the 2009 Press Ganey Emergency Department Pulse Report, patients in the United States spent an average of four hours and three minutes (4.05 hours) waiting in the Emergency Department. The Massachusetts’ (State) average wait time was 4.3 hours.

Wait Times in the Emergency Departments

The average wait to time to see an ophthalmologist in the Mass. Eye and Ear Emergency Department is almost half the average state and national wait times.
During a one-year period, 95 patients suffered open-globe injuries that required urgent surgical repair by the Mass. Eye and Ear Eye Trauma Service. The mean time from initial arrival time at the Mass. Eye and Ear Emergency Department to arrival time in the Mass. Eye and Ear Operating Room was 9.1 hours (range: 40 minutes to 22.2 hours), with 66 percent of patients taken to the operating room in under 12 hours. All 95 patients (100 percent) were taken to the operating room within 24 hours, the standard of care for this type of ophthalmic trauma.

100% of patients needing emergency surgery for ocular trauma are taken to the operating room within 24 hours of arrival to Mass. Eye and Ear.

**Eye Trauma Surgery:**
**Time to surgical repair for open-globe injuries**

*January 2009 to December 2009*
The photos below illustrate a patient who had eye trauma. At presentation to the Emergency Department, the pre-operative vision was “light perception” (left photo). The patient was in the operating room by 6.7 hours, and his post-operative vision was 20/20 (right photo).

*Photos courtesy Ankoor Shah, MD, PhD*
During a 7.5-year period (January 2000 to July 2007), 675 open-globe injuries were treated at the Mass Eye and Ear. Intravenous vancomycin and ceftazidime were started on admission and stopped after 48 hours. Patients were discharged on topical antibiotics, corticosteroids, and cycloplegia. Of these 675 eyes, 558 had at least 30 days of follow-up (mean, 11 months). The overall percentage of endophthalmitis was 0.9 percent (or 5/558 cases). Three were culture-positive cases, and two were culture-negative cases.

A standard protocol including surgical repair by a dedicated eye-trauma service and 48 hours of IV antibiotics were associated with a post-traumatic endophthalmitis percentage of less than one percent. A review of the literature suggests that endophthalmitis rates around the world range from 2.6 to 17 percent (mean 6.8 percent). The United States National Eye Trauma Registry has reported an endophthalmitis rate of 6.9 percent after open-globe repair.

Based on the Mass. Eye and Ear experience and the low percentage of cases with endophthalmitis, we recommend that institutions adopt a standardized protocol for treating open-globe injuries and consider the use of prophylactic systemic antibiotics.


N = 95
Sympathetic ophthalmia is a devastating and visually-threatening problem that can occur in the non-injured eye after an open-globe injury. It has been suggested that an eye with no visual potential following trauma should be enucleated (removed) within two weeks of the initial traumatic event. In theory, this may decrease the risk of sympathetic ophthalmia in the “sympathizing” or fellow eye. Previously reported rates of sympathetic ophthalmia in the recent literature are about 0.6 percent for non-surgical ocular wounds.

From January 2000 to June 2007, 660 open-globe injuries were treated by the Mass. Eye and Ear’s Eye Trauma Service. Fifty-five eyes have undergone enucleation (including four eviscerations), 11 primarily and 44 secondarily. Two patients (0.3 percent) developed sympathetic ophthalmia but have maintained good vision in the sympathizing eye with prompt diagnosis and treatment.

The practice of Mass. Eye and Ear’s Neuro-Ophthalmology Service began in the 1940s under the guidance of Dr. David Glendenning Cogan, one of the most influential and seminal contributors to the fields of neuro-ophthalmology and ophthalmic pathology. In this same spirit of excellence, our Neuro-Ophthalmology Service today offers the highest level of expertise and care to patients available anywhere in the world. Our three, full-time faculty physicians are trained and licensed in both ophthalmology and neurology. Worldwide, only eight other neuro-ophthalmologists are trained in both specialties, and no other Neuro-Ophthalmology Service retains more than one faculty member with dual training.

Mass. Eye and Ear’s Neuro-Ophthalmology Service provides regular and emergency evaluation of patients with optic neuritis, ischemic optic neuropathy, brain tumors involving the optic nerves or chiasm, unexplained vision loss, strokes that cause visual loss or double vision, transient monocular blindness, migraine with visual symptoms, myasthenia gravis, multiple sclerosis, mitochondrial disease, and muscular disease that affects the eye. The team specializes in the diagnosis of diseases of the optic nerve and brain that reduce vision as well as diseases that cause double vision. On a daily basis, our expert physicians collaborate closely with the neurologists and neurosurgeons of the Massachusetts General Hospital (MGH) and provide consultation services to MGH inpatients. In addition, one of our specialists includes evaluation and treatment of adult strabismus in his practice.
The Brain/Eye Connection

- left visual field
- right visual field
- left eye
- right eye
- temporal
- nasal
- optic chiasm
- optic nerve
- brain
- optic radiations
- occipital lobe
- primary visual cortex
Neuro-Ophthalmology Service: Types of services performed in neuro-ophthalmology

October 2008 to September 2009

Types of services offered by the neuro-ophthalmology service include the following:

- Outpatient visits (4,356)
- Surgery cases (47)
- Massachusetts General Hospital (MGH) consults (413)
- Emergent consults (247)
- Same day MRI scan interpretation

In addition to 4,356 outpatient visits per year:

- Surgical volume: 450
- MGH consults: 400
- Emergent consults: 350

N = 707
Of the patients seen by the Neuro-Ophthalmology service from October 2008 to September 2009, 9% were pediatric patients.
In 1998, Drs. Rizzo and John Loewenstein performed the first surgery to insert a microfabricated electrode array onto the retina of a human eye. This was a major milestone toward the development of an advanced retinal prosthesis, which will electrically stimulate healthy nerve cells in the retinas of patients with either retinitis pigmentosa or age-related macular degeneration to restore some measure of vision.

This is a graphic image of the retinal prosthesis that has been designed by the Boston Retinal Implant Project. The Project was founded at the Mass. Eye and Ear and exists as a collaborative effort with the Massachusetts Institute of Technology and the Veterans Administration. External electrical components are housed within a pair of glasses; other electronic components are implanted around and behind the eyeball. The implanted components will not be visible from the outside. The electronic components on the glasses will communicate wirelessly to the implanted components.
The Ocular Immunology and Uveitis Service at Mass. Eye and Ear provides diagnostic and therapeutic care to patients with inflammatory eye disease. Patients are referred by other ophthalmologists to our specialists for surgical and medical treatment of infectious and immunologic ocular disorders. The Service also provides subspecialty consultation and advice at the request of referring ophthalmologists.

Uveitis refers to inflammation inside the eye and is the third leading cause of blindness worldwide. Treatment for conditions related to ocular immunology and ocular inflammatory disorders requires a multi-disciplinary approach that overlaps internal medicine and ophthalmology. Our Immunology and Uveitis Service physician scientists are cross-trained in Mass. Eye and Ear's retina, cornea, and immunology and uveitis services and offer a unique combination of skills and expertise. In addition to patient care and physician education, they are involved in scientific studies to define the diagnostic, treatment and prognostic characteristics of immunology and uveitis patients. The results of their efforts afford patients the most novel methods and treatments available today for treating ocular inflammatory diseases.
Almost 4,000 patient visits occur annually at the Mass. Eye and Ear Uveitis Service. From February 2009 to January 2010, 17.1 percent (669 of 3,910) of these visits were new patients who were referred to the Uveitis Service by other ophthalmologists requesting subspecialty consultation and advice.
For more than 25 years, Mass. Eye and Ear’s Vision Rehabilitation Center (VRC) staff has assisted thousands of patients who suffer from a wide-range of eye conditions that restrict their daily activities, mobility, productivity and independence. Under the direction of Dr. Mary Lou Jackson, the ultimate goal of vision rehabilitation services is to assist patients with partial vision loss learn how to effectively use all of their remaining vision.

Comprehensive vision rehabilitation care addresses five areas:

- Reading rehabilitation
- Activities of daily living
- Safety
- Continued participation in one’s community
- Well-being, including adjustment to vision loss

Each patient is evaluated to determine the appropriate rehabilitation interventions. These may include magnification aids, computer accessibility training, and referral to an occupational therapist for training in using devices and strategies to accomplish daily activities independently and safely.
The VRC houses one of New England’s only Scanning Laser Ophthalmoscope Macular Perimeters (SLO). This unique tool produces a real-time, high-resolution image of the patient’s retina which produces a map of its functioning areas. With this tool, VCR staff is able to understand a patient’s visual functioning and, if appropriate, teach the patient to effectively use alternate peripheral areas of the retina. On average, a thousand scans are performed each year.
A total of 33 patients were diagnosed with retinal degeneration/dystrophy, 14 with degenerative myopia or angioid streaks, 23 with retinal detachment, 104 with glaucoma (all types), 42 with diabetic retinopathy (all types), 287 with age-related macular degeneration (AMD), 48 with neurologic/brain disease, 27 with non-AMD related macular disease, 69 with optic atrophy/neuritis, and 146 with other diseases (including: cataract, aromatic amino acid metabolism disorder, neoplasm, amblyopia, infectious disease, and vascular events).
The newly renovated Vision Rehabilitation Department, which opened in 2009, features a number of improvements to help provide better care and better access to patients with vision impairments.
We prospectively evaluated the patient experience at the Mass. Eye and Ear Vision Rehabilitation Center during a one-month period using a four-question survey developed for this Outcomes book. The results are depicted in the following summary:

<table>
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<tr>
<th>Service: Patient experience questionnaire results</th>
<th>December 2009 to January 2010</th>
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<tr>
<td>96.3% rated the quality of service excellent, and 3.7% very good.</td>
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<td>100% found the staff and physicians to be friendly and courteous.</td>
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<td>100% agreed that the doctors and staff explained vision rehabilitation options clearly.</td>
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<tr>
<td>100% reported that they were very likely or extremely likely to recommend the Mass. Eye and Ear Vision Rehabilitation Center to others.</td>
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Comprehensive Ophthalmology and Cataract Consultation
617-573-3202
- Sheila Borboli-Gerogiannis, MD, FACS
- Stacey C. Brauner, MD
- Kenneth Chang, MD, MPH
- Sherleen H. Chen, MD, FACS
- Matthew F. Gardiner, MD
- Scott Greenstein, MD, FACS
- Carolyn E. Kloek, MD

Cornea and External Disease
617-573-3938
- James Chodosh, MD, MPH
- Joseph B. Ciolino, MD
- Kathryn A. Colby, MD, PhD
- Reza Dana, MD, MSc, MPH
- Claes H. Dohlman, MD, PhD
- Pedram Hamrah, MD
- Deborah S. Jacobs, MD
- Ula V. Jurkunas, MD
- Deborah P. Langston, MD, FACS
- Samir A. Melki, MD, PhD
- Roberto Pineda, II, MD

Emergency Ophthalmology and Eye Trauma
Emergency Department: 617-573-3431
- Matthew F. Gardiner, MD
Eye Trauma: 617-573-3022
- Ankoor S. Shah, MD, PhD
- Lynn J.P. Perry, MD, PhD

Glaucoma
617-573-3670
- Stacey C. Brauner, MD
- Teresa C. Chen, MD, FACS
- Cynthia L. Grosskreutz, MD, PhD
- Louis R. Pasquale, MD
- Douglas J. Rhee, MD
- Lucy Q. Shen, MD
- Janey L. Wiggs, MD, PhD

Neuro-Ophthalmology and Adult Strabismus*
617-573-3412
- Dean M. Cestari, MD*
- Simmons Lessell, MD
- Joseph F. Rizzo, III, MD

Ophthalmic Pathology
617-573-3319
- Frederick A. Jakobiec, MD, DSc
- Thaddeus P. Dryja, MD
- Anat Stemmer-Rachamimov, MD

Ophthalmic Plastic and Reconstructive Surgery
617-573-5550
- Aaron M. Fay, MD
- Nancy Kim, MD, PhD
- Francis Sutula, MD
- Manoj M. Thakker, MD
Pediatric Ophthalmology
and Strabismus
(a collaboration on-site with Children’s Hospital)
617-355-6401
- Linda R. Dagi, MD
- Gena Heidary, MD, PhD
- Melanie A. Kazlas, MD
- Danielle M. Ledoux, MD
- Iason Mantagos, MD

Refractive Surgery
617-573-3234
- Ula V. Jurkunas, MD
- Samir A. Melki, MD, PhD
- Roberto Pineda, II, MD
- Pedram Hamrah, MD

Retina and/or
Retinal Degenerations
617-573-3288
- Daniel D. Esmaili, MD
- Evangelos S. Gragoudas, MD
- Ivana K. Kim, MD
- John I. Loewenstein, MD
- Joan W. Miller, MD
- Shizuo Mukai, MD
- Lucia Sobrin, MD, PhD
- Demetrios Vavvas, MD, PhD
- Lucy HY Young, MD, PhD, FACS

Retinal Degenerations/
Electroretinography (ERG) Service
617-573-3621
- Eliot L. Berson, MD
- Alexander R. Gaudio, MD
- Michael A. Sandberg, PhD

Uveitis and Immunology
617-573-3591
- Reza Dana, MD, MSc, MPH
- George N. Papalioudis, MD
- Lucia Sobrin, MD
- Lucy HY Young, MD, PhD

Vision Rehabilitation
617-573-4177
- Mary Louise Jackson, MD

Contact Lens
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- Charles D. Leahy, OD, MS
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