QUALITY AND OUTCOMES
Department of Ophthalmology
2015
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Leading the way in making outcomes data publicly available...

Dear Colleagues in Health Care,

Physicians today want to practice evidence-based medicine, so that they can diagnose and treat patients using the best available data. To accomplish this, they usually refer to randomized clinical trials in which carefully matched groups of patients are studied comparing an intervention, drug or 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 clinical practice involves studying outcomes. How well do our patients see after cataract surgery? How successful are our retina reattachment procedures? How often do our patients develop postoperative infections? In other words, how well do our doctors, nurses and health care professionals manage their patients?

Since 2010, Massachusetts Eye and Ear has led the medical community in the development of ophthalmology outcome measures related to our areas of expertise, and we have consistently reported on these measures in the Quality and Outcomes book. These measures have evolved and grown considerably since our first issue. The report provides us an avenue for transparency and accountability, which we feel is very important. We hope to set the standard for outcomes achieved, and to be able to document our continuing improvement through the information included in these pages.

The Board of Quality Care Committee and the Steering Committee for Quality would like to thank Chief Quality Officer for Ophthalmology, Dr. Teresa Chen, and Associate Chief for Clinical Operations, Dr. Matthew Gardiner, for their leadership in this project. We also wish to thank the clinicians, technicians, nurses and other staff at Mass. Eye and Ear who work so hard to provide the highest quality care each day.

For more information about Mass. Eye and Ear’s Quality Program initiatives and to view an electronic copy of this report, please visit our website at www.MassEyeAndEar.org/Quality.

John Fernandez
President and CEO
Massachusetts Eye and Ear

Joan W. Miller, MD
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Massachusetts Eye and Ear
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About the Quality and Outcomes Program

Each year, Massachusetts Eye and Ear publishes the Quality and Outcomes book to objectively evaluate our quality and outcomes for the public. Now in its sixth year of reporting outcomes, the book serves as a testament to the premier care we provide for our patients at Mass. Eye and Ear, and it is our hope that other institutions may be inspired to consider publishing similar reports.

We have been a leader in the medical community for quality and outcomes in a variety of ways. In ophthalmology—for instance—the international benchmark in cataract surgery for achieving within 1 diopter of target refraction is between 71 and 94 percent. Even though we have always exceeded international benchmarks, our latest data show that we now exceed the upper range, with 96 percent of our patients achieving target refraction criteria. Our outcomes measure was submitted to Medicare and is now a nationwide outcomes measure. Mass. Eye and Ear also has some of the lowest reported rates of endophthalmitis after intravitreal injections, which is one of the most common outpatient procedures in ophthalmology.

Behind the Quality and Outcomes book is the Mass. Eye and Ear Quality Program, an institutional initiative directed by the Board of Quality Care Committee and the Steering Committee for Quality, which meets weekly to review issues in four core areas: outcomes, provider excellence, clinical incidents response and process improvement. These meetings provide a forum for close interaction between quality leaders in Ophthalmology, Otolaryngology, Anesthesia, Nursing, Legal, Information Services and others, fostering a team approach to achieve best practices and enhance communication between functional areas of the hospital.

When problems do arise, clinical incidences are tracked electronically and subsequently reviewed by the Steering Committee for Quality, which works together to identify trends and implement a correction plan. We work with other hospital committees, including the OR committee, infection control, medical records, patient family advisory council and others, when we need their expertise and advice on certain issues.

For example, in a past Steering Committee for Quality meeting, we had addressed a cataract surgery case with a wrong intraocular lens (IOL), a serious reportable event. During the post-event review process, we found that poor handwriting on the order form was the root cause of this wrong IOL. We corrected the problem by mandating that all IOL orders be typed. We published our “lessons learned” in the journal Ophthalmology in 2012, addressing the issues associated with wrong IOLs, which is one of the most common preventable medical errors in ophthalmology.
In 2015, Dr. Miller and I shared our experience in creating and implementing new policies in a paper published in JAMA Ophthalmology, “Sentinel Events, Serious Reportable Events and Root Cause Analysis.” The paper describes our multidisciplinary team approach for identifying the primary or root cause of sentinel events, with the ultimate goal of improving quality and outcomes in ophthalmology. Our article is one of the first to demonstrate how leadership can create and reinforce new policies that improve ophthalmology outcomes.

Today, the Mass. Eye and Ear Quality Program remains committed to publishing a robust and transparent assessment of quality care report each year. We hope you find the publication interesting and useful, and we welcome your comments and feedback. It is our hope that we can continue to set new standards for outcomes achieved in our field.

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Chief Quality Officer for Ophthalmology
Department of Ophthalmology
Massachusetts Eye and Ear
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Ophthalmology Clinical Leadership in Quality: 2015

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Chief Medical Officer, Chief of Anesthesiology, Massachusetts Eye and Ear
About Massachusetts Eye and Ear

Founded in 1824, Massachusetts Eye and Ear is a pre-eminent specialty, teaching and research hospital dedicated to caring for disorders of the eyes, ears, 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 visionary health care leaders. Our world-renowned experts are continuously innovating in the fields of translational and bench research, turning insights into cures that benefit countless 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 Partners eCare, a highly integrated health and administrative information system that primarily uses the software vendor Epic. Partners eCare is utilized by the majority of Harvard Medical School’s network of hospitals and affiliates, facilitating quick and easy communication among referring physicians and Mass. Eye and Ear’s consulting ophthalmologists, otolaryngologists and radiologists. It also enables our physicians to instantly access our specialists, affording seamless and rapid access to some of the best ophthalmology and otolaryngology resources available.

2014 Hospital Statistics
(Jan 1 – Dec 31, 2014)

Patient Volume
Outpatient services ................................................................. 411,917
Ambulatory surgery services and laser ................................ 27,715
Inpatient surgical services .................................................. 998
Emergency Department services ........................................ 19,898
Discharges ............................................................................. 1,263

Beds ......................................................................................... 41

Overall Operating Revenue ................................................. $379,146,039

For more information, visit MassEyeAndEar.org/Locations.
Massachusetts Eye and Ear
Ophthalmology Department

At Mass. Eye and Ear/Harvard Medical School Department of Ophthalmology, we have nearly two centuries of experience in developing innovative approaches to treating eye disease and reducing blindness worldwide. We founded subspecialty training in the areas of cornea, retina and glaucoma, and have pioneered tools and treatments for numerous diseases and conditions ranging from retinal detachment to age-related macular degeneration to corneal scarring. Our patient-centered core values focus on delivering the highest quality of care through education, innovation and service excellence.

We Are:
• The primary teaching hospital of the Harvard Medical School Department of Ophthalmology
• Home to Schepens Eye Research Institute, Howe Laboratory, and Berman-Gund Laboratory for the Study of Retinal Degenerations
• Accelerating research and discovery through our multidisciplinary institutes and subspecialty-based centers of excellence:
  Ocular Genomics Institute
  Ocular Regenerative Medicine Institute
  Infectious Disease Institute
  Age-related Macular Degeneration Center of Excellence
  Cornea Center of Excellence
  Diabetic Eye Disease Center of Excellence
  Glaucoma Center of Excellence
  Mobility Enhancement & Vision Rehabilitation Center of Excellence
  Ocular Oncology Center of Excellence

Clinical Affiliations

Massachusetts General Hospital (MGH) Department of Ophthalmology

• Mass. Eye and Ear provides comprehensive and subspecialty care and inpatient consultations to MGH patients, including 24/7 emergency eye care and trauma coverage. Mass. Eye and Ear clinicians also coordinate Neuro-Ophthalmology and Burn Unit consultations at MGH.

• Mass. Eye and Ear staff screen MGH patients with or at high risk for diabetic eye disease on a same-day basis in the main campus Retina Service and through MGH’s Chelsea HealthCare Center teleretinal screening program.

Academic Affiliations

Harvard Medical School
Massachusetts General Hospital
Brigham and Women’s Hospital
Joslin Diabetes Center/Beetham Eye Institute
Boston Children’s Hospital
Beth Israel Deaconess Medical Center
Veterans Affairs Boston Healthcare System
VA Maine Healthcare System
Cambridge Health Alliance
Aravind Eye Hospital, India
Eye and ENT Hospital of Fudan University, Shanghai, China
For more information about the Mass. Eye and Ear Quality Program or the Department of Ophthalmology, please visit our website at www.MassEyeAndEar.org.

• Mass. Eye and Ear’s new Same Day Service evaluates urgent and emergent eye concerns of MGH patients as a less costly, more efficient alternative to Emergency Department care.

Joslin Diabetes Center/Beetham Eye Institute (BEI)

• Mass. Eye and Ear and BEI clinicians provide coordinated, integrated and comprehensive care to patients throughout Boston to prevent, diagnose and treat patients at risk for diabetic eye disease.

Brigham and Women’s Hospital (BWH)

• Mass. Eye and Ear ophthalmologists provide subspecialty care in glaucoma, cornea, and pediatric retina surgery at Boston Children’s Hospital.

• BWH patients also receive a full range of ophthalmic care including Same Day Service urgent consultation and evaluations at Mass. Eye and Ear, Longwood, staffed by Mass. Eye and Ear clinicians with participation from Joslin diabetes specialists.

Children’s Hospital Ophthalmology Foundation

• Mass. Eye and Ear ophthalmologists provide subspecialty care in glaucoma, cornea, and pediatric retina surgery at Boston Children’s Hospital.

• Children’s Hospital clinicians staff the comprehensive pediatric ophthalmology and strabismus service at Mass. Eye and Ear.

Ophthalmology Resources at Mass. Eye and Ear

• Highly skilled teams provide a full spectrum of primary and subspecialty ophthalmic care.

• Our dedicated eye emergency department is available 24/7.

• The Morse Laser Center provides advanced laser procedures using state-of-the-art refractive, glaucoma, retinal and anterior segment lasers.

• The Ocular Surface Imaging Center enables rapid, non-invasive corneal biopsies.

• Our Inherited Retinal Disorders Service performs evaluations of patients referred for diagnosis, prognosis, genetic counseling and treatment of retinal degenerative disorders.

• The David Glendenning Cogan Laboratory of Ophthalmic Pathology provides enhanced diagnostic services in conjunction with the MGH Surgical Pathology Service.

• Our expanding Optometry Service provides screening and vision care in the context of ophthalmic practice.
• The full service Contact Lens Service specializes in therapeutic fits, bandage and specialty contact lenses.

• The Howe Library houses one of the most extensive ophthalmology research collections in the world.

• The Mass. Eye and Ear Medical Unit is staffed by Mass. Eye and Ear hospitalists and nurse practitioners.

• The Mass. Eye and Ear Radiology Department houses a dedicated MRI/CT imaging suite.

• Our dedicated Social Work and Discharge Planning Department provides information, counseling and referral services to patients and their families.

• The International Program offers patients assistance with appointments, transportation, accommodations and language translation.

• Mass. Eye and Ear’s Retina Service houses a dedicated ophthalmic ultrasound imaging suite as part of the Minda de Gunzburg Retinal Imaging Center.

Eye Anatomy

• The Ocular Melanoma Center, a premier referral center for the diagnosis and treatment of eye tumors, draws patients from around the world.

• The Altschuler Surgical Training Laboratory (estimated completion date: fall 2016) will serve as a cornerstone of the surgical training program at Mass. Eye and Ear/Harvard Ophthalmology, and will house state-of-the-art surgical equipment, training machines for vitreoretinal and cataract surgery, a proctor station with a plasma screen, and other technological improvements.

Key Statistics: Mass. Eye and Ear Ophthalmology
January 1 – December 31, 2014

<table>
<thead>
<tr>
<th>Subspecialty</th>
<th>Patient Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outpatient Ophthalmology Visits</strong></td>
<td></td>
</tr>
<tr>
<td>Comprehensive Ophthalmology</td>
<td>37,181</td>
</tr>
<tr>
<td>Trauma</td>
<td>420</td>
</tr>
<tr>
<td>Cornea</td>
<td>18,982</td>
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<tr>
<td>Optometry</td>
<td>12,005</td>
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<tr>
<td>Ophthalmic Plastic, Reconstructive Surgery</td>
<td>7,932</td>
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<tr>
<td>Glaucoma</td>
<td>18,834</td>
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<tr>
<td>Immunology and Uveitis</td>
<td>6,428</td>
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<tr>
<td>Inherited Retinal Disorders Service</td>
<td>694</td>
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<tr>
<td>Neuro-Ophthalmology</td>
<td>5,061</td>
</tr>
<tr>
<td>Retina</td>
<td>36,176</td>
</tr>
<tr>
<td>Vision Rehabilitation Service</td>
<td>942</td>
</tr>
<tr>
<td>Total Outpatient Ophthalmology Visits</td>
<td>144,655</td>
</tr>
</tbody>
</table>

**Emergency Room Visits**

Total number of Ophthalmology visits .................. 12,584

**Surgical Procedures**

Total number of Ophthalmology surgeries ................ 11,387

Total Ophthalmology laser procedures .................. 3,025

   Refractive                                        | 626            |

Total intravitreal injections   ......................... 9,458
Emergency Department:
Ophthalmology Emergency Visits

This bar graph shows the number of ophthalmology patients seen monthly by the Mass. Eye and Ear Emergency Department during the past six calendar years. Throughout this time, the Emergency Department maintained a high volume of ophthalmic emergency visits, with an average of 1,060 patients per month in 2009, 1,050 in 2010, 1,091 in 2011, 1,146 in 2012, 1,142 in 2013 and 1,189 in 2014. Patient volume generally increases in the summer.

Emergency Department:
Ophthalmology Visit Times

The average ophthalmology visit time in the Mass. Eye and Ear Emergency Department for 2014 was 3.1 hours. The visit time is defined as the total time from when the patient walked in the door at the Mass. Eye and Ear Emergency Department to when the patient finished the visit with the ophthalmologist. According to the 2010 Press Ganey Emergency Department Pulse Report, patients across the United States spent an average of four hours and seven minutes (4.12 hours) per emergency room (ER) visit. The Massachusetts state average visit time was 4.06 hours.

For the past six years, the average ophthalmology visit time in the Mass. Eye and Ear Emergency Department was better than the average national and state visit times.
Emergency Department: Distribution of Ophthalmology Diagnoses

During calendar year 2014, there were 14,270 ophthalmic emergency visits to the Mass. Eye and Ear Emergency Department. Of these, 12,610 visits were initial encounters and are included in this distribution analysis. The following graph depicts the top 20 diagnoses for all ophthalmic emergency visits during 2014.

“Left without being seen” (LWBS) refers to patients who present to an emergency department but leave before being seen by a physician. The Mass. Eye and Ear Emergency Department reported a LWBS rate of 1.0% (146 patients for all 14,270 ophthalmic emergency visits) in 2014; similar results were reported for calendar years 2012 and 2013. According to a 2009 report by the Society for Academic Emergency Medicine, the national LWBS rate is 1.7%. LWBS rates vary greatly between hospitals; a review of the literature suggests a national range of 1.7% to 4.4%.

References:
In a retrospective review of 124 pediatric open-globe injuries managed by the Eye Trauma Service and/or Retina Service between February 1999 and April 2009, analysis showed a median visual acuity at presentation of “hand motion” (N = 123), and a final best corrected median visual acuity of 20/40 (N = 124) at ten months median follow-up.

**Eye Trauma Surgery: Time to Surgical Repair for Open-Globe Injuries**

During calendar year 2014, 118 patients suffered open-globe injuries that required urgent surgical repair by the Eye Trauma Service. Of those patients needing emergency surgery for ocular trauma, 118 (100.0%) were taken to the operating room within 24 hours of arrival at Mass. Eye and Ear.

The mean time from presentation at the Emergency Department to arrival in the operating room was 430.8 minutes, or 7.2 hours (range: 0 minutes to 22 hours). Of the 118 patients, 93 (78.8%) were taken to the operating room in under 12 hours.

Multiple studies suggest the benefit of repairing open-globe injuries within 12 to 24 hours, in particular for the prevention of endophthalmitis. In order to assure that we are able to always provide service within this timeframe, backup trauma surgeons are available to care for simultaneous injuries needing care at the main campus and at affiliate hospitals.

**Eye Trauma Surgery: Postoperative Median Vision**

During the 2014 calendar year, 119 eyes of 118 patients had open-globe repair by the Mass. Eye and Ear Eye Trauma Service for all surgical locations. Of these 118 patients, visual acuity at presentation was recorded in 117 patients. Visual acuity was not possible in one patient due to the patient’s mental status. At the time of analysis, 74 eyes of 73 patients had five months or more of follow-up, and only these individuals were analyzed for preoperative and postoperative vision. Patients with less than five months of follow-up were excluded from the analysis.

During the 2014 calendar year, the median preoperative vision was “hand motion” and the median postoperative vision at the closest follow-up visit after five months was 20/100.

Visual prognosis after ocular trauma is highly dependent on the severity of the initial trauma, but these data show that patients suffering from traumatic eye rupture can regain useful vision after surgery.

During calendar year 2014, 118 patients had open-globe repair by the Eye Trauma Service for all surgical locations. Of these 118 patients, two (1.7%) developed endophthalmitis. Low infection rates were also reported for calendar years 2009, 2010, 2011, 2012, and 2013, as shown in the graph.

The first case of endophthalmitis was a 31-year-old male with delayed presentation to Mass. Eye and Ear (> 24 hours) and with Zone I injury. He had surgical repair of a corneal laceration, but lensectomy was deferred at the time. On postoperative day 4, he had increased inflammation, which was presumed to be from lens capsular violation. He underwent phacoemulsification with intraocular lens, but on the third day after the cataract surgery, he presented with increased inflammation, pain, and decreased vision. Vitreous culture grew coagulase-negative staphylococci. Although his vision on presentation had been 20/30, his vision at 15 months was 20/500 after three retinal detachment repairs.

The other case of endophthalmitis was a 34-year-old male with a Zone II injury from a metal shim. One day after repair of a 1mm scleral wound that was 4 mm posterior to the limbus, the patient had 20/25 vision but also had extensive anterior chamber and fibrin reaction, which was concerning for endophthalmitis. He was treated with intravitreal antibiotics; however, the vitreous culture was negative. His postoperative course was complicated by a macula-off retinal detachment. His final best corrected vision was 20/50 with an aphakic contact lens.

Prior to 2009, data were collected on all open-globe injuries treated from January 2000 to July 2007. During this 7.5-year period, 675 open-globe injuries were treated at 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 cycloplegics. Of these 675 eyes, 558 had at least 30 days of follow-up (mean, 11 months). The overall rate of endophthalmitis was 0.9% (5/558 cases).

The standard Mass. Eye and Ear protocol for eye trauma (i.e. surgical repair by a dedicated trauma team and 48 hours of intravenous antibiotics) is associated with post-traumatic endophthalmitis rates far below international benchmarks. A review of the literature suggests that endophthalmitis rates around the world range from 2.6% to 17%. The United States National Eye Trauma Registry has reported an endophthalmitis rate of 6.9% after open-globe repair.¹


Eye Trauma Surgery: Rates of Endophthalmitis After Open-Globe Repair

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The Comprehensive Ophthalmology and Cataract Consultation Service at Mass. Eye and Ear provides a full spectrum of integrated patient care, including annual and diabetic eye exams, prescriptions for eyeglasses, continued management of a variety of eye problems, and subspecialty referrals for advanced care as needed. The most common surgery performed at Mass. Eye and Ear is cataract extraction with intraocular lens implantation.

Cataract Surgery: Achieving Target Refraction (Spherical Equivalent)

During the 2014 calendar year, the Comprehensive Ophthalmology and Cataract Consultation Service performed cataract surgery on 1,927 eyes. This chart depicts the results of the 1,829 eyes that had at least one month of follow-up data. Of these 1,829 eyes, 1,759 (96.2%) achieved within one diopter of target refraction after cataract surgery.

References:

Similar results were reported for calendar years 2010, 2011, 2012, and 2013. These results are also consistent with an earlier 12-month period between July 2008 and June 2009, when data collection began. For the past six years, the Comprehensive Ophthalmology and Cataract Consultation Service has consistently met or exceeded international benchmarks for successful cataract surgery.
The Mass. Eye and Ear Comprehensive Ophthalmology Service has some of the lowest intraoperative complication rates compared to international benchmarks.

Cataract Surgery: Intraoperative Complication Rates

Of the 1,927 cataract surgeries performed by the Comprehensive Ophthalmology and Cataract Consultation Service during the 2014 calendar year at all surgical locations, only 32 (1.7%) had intraoperative complications. These results are displayed in the graph above. Similar results were reported in calendar years 2012 and 2013, during which only 36/1,464 (2.5%) and 44/1,719 (2.6%) of cataract surgeries, respectively, had intraoperative complications.

Mass. Eye and Ear 2014 Intraoperative Complication Rates:
- Descemet tear: 1/1,927 (0.05%)
- Posterior capsule tear and/or vitreous loss: 20/1,927 (1.0%)
- Dropped lens/retained lens fragment: 6/1,927 (0.3%)
- Zonular dialysis: 5/1,927 (0.3%)

International Benchmarks:1-5
- Descemet tear: 0% to 0.9%
- Posterior capsule tear and/or vitreous loss: 0.3% to 4.4%
- Dropped lens/retained lens fragment: 0% to 1.7%
- Zonular dialysis: 0.1% to 1.2%

References:
The Retina Service at Mass. Eye and Ear is one of the largest subspecialty groups of its kind in the country. Our clinicians are highly skilled at diagnosing and treating a full range of ocular conditions, including macular degeneration, diabetic retinopathy, retinal detachments, ocular tumors, intraocular infections, and severe ocular injuries.

Retina Surgery:
Retinal Detachment and Retinal Detachment Repair

Primary rhegmatogenous retinal detachment is one of the most common retinal conditions that require surgical repair by the Mass. Eye and Ear Retina Service. During calendar year 2014, the Retina Service performed surgical procedures to repair rhegmatogenous retinal detachments that included pneumatic retinopexy, pars plana vitrectomy, and/or scleral buckle surgery.

Single surgery success rate of retinal reattachment was determined for primary, uncomplicated rhegmatogenous retinal detachments of less than one month duration. Of a total of 221 eyes with primary rhegmatogenous retinal detachment, 175 (79.2%) of the retinas were successfully reattached after one surgery at three months or greater of follow-up. Similar results were reported for calendar years 2012 and 2013, when 138/173 (80.0%) and 168/220 (76.4%) of retinas, respectively, were successfully reattached after the first surgery.

Benchmarks were determined from a literature review of studies that reported single surgery success rates for at least two of the three surgical techniques in this analysis (i.e., pneumatic retinopexy, pars plana vitrectomy, and/or scleral buckle). These single surgery success rates are comparable to international benchmarks reported in the literature, which range from 59% to 95% for primary rhegmatogenous retinal detachment repair.  

References:
Retina Surgery:
Final Retinal Reattachment Rate for Primary Rhegmatogenous Retinal Detachment

Retinal reattachment was successfully achieved in all 221 eyes with a primary rhegmatogenous retinal detachment during calendar year 2014. This success rate reflects eyes that had one or more surgeries, which may have included pars plana vitrectomy, scleral buckle, and pneumatic retinopexy. These 221 eyes had at least three months of follow-up from the date of the last surgery. The smaller number of cases in calendar year 2010 may be attributable to more stringent follow-up criteria of having at least five months of follow-up data.

References:

Macular Hole Surgery:
Single Surgery Success Rate at Three Months

During calendar year 2014, the Mass. Eye and Ear Retina Service treated 24 eyes of 22 patients with first onset, acute, non-traumatic macular holes. A total of 27 surgeries (including pars plana vitrectomy, membrane peel, and gas tamponade) were performed on 24 eyes. The single surgery success rate for macular hole closure was determined for primary, uncomplicated macular holes of less than six months duration.

Of the 24 eyes that underwent primary macular hole surgery in 2014, 22 eyes (91.7%) achieved surgical success with a single operation. Success was defined as any primary macular hole that remained fully closed for longer than three months after the first surgery. Similar results were reported in calendar year 2013, during which time 33 eyes (93.9%) with primary macular hole achieved surgical success with a single operation. A review of the literature suggests that single surgery success rates for macular hole surgery range from 89.8% to 93.0%.

References:
During the 2014 calendar year, the Mass. Eye and Ear Retina Service performed 8,853 intravitreal injections. Of these, two cases of endophthalmitis after intravitreal injection were identified. In one case of acute endophthalmitis, the patient presented five days after the injection with anterior chamber inflammation and seven days after the injection with vitreous cells. The patient underwent a vitreous tap with injection of intravitreal antibiotics. Vitreous cultures showed no growth. At six months follow-up after treatment, best corrected visual acuity returned to the patient’s baseline vision of “counting fingers” (CF). In the second case, the patient presented with a hypopyon and vitreous debris five days after the injection. Anterior chamber and vitreous taps were performed with injections of antibiotics. The vitreous culture was negative, but the anterior chamber culture revealed Staphylococcus lugdunensis. The patient’s baseline vision was 20/30, but at 4 months follow-up, the best corrected visual acuity was 20/80.

In order to identify cases of acute endophthalmitis, a retrospective review was performed of all consecutive eyes that underwent intravitreal injections from January 1, 2009 to December 31, 2014. During this six-year period, 29,903 intravitreal injections were performed by the Mass. Eye and Ear Retina Service. The rate of endophthalmitis after intravitreal injection during this six-year period was 0.02% (five out of 29,903 injections).

References:
4. VanderBeek BL, Bionaffini SG, Ma L. Association of compounded bevacizumab with postinjection endophthalmitis. JAMA Ophthalmol 2015; 133:1159-64. 

Acute endophthalmitis is a rare potential complication of intravitreal injections. Mass. Eye and Ear’s rates of endophthalmitis after intravitreal injection are among the lowest compared to international benchmarks.
Retina Surgery

Ocular Melanoma Center – Globe Perforation Rate from Surgery

Tumors located within the eye can be challenging to diagnose and treat effectively without causing damage to the eye, resulting in a loss of vision. Proton beam irradiation is one of the most effective therapies for treating intraocular tumors while minimizing visual loss from radiation complications.1 Before receiving radiation treatment for uveal melanoma, most patients have tantalum ring surgery to localize the tumor. Perforation of the globe is a potential complication during tumor localization surgery.

During calendar year 2014, the Ocular Melanoma Center at Mass. Eye and Ear performed tantalum ring surgery in preparation for proton beam irradiation on 105 eyes. Zero cases of globe perforation from surgery were reported. There were also no cases of globe perforation reported in 2012 and 2013.

Glaucoma Surgery: Trabeculectomy and Tube Shunt Infection Rates

The most common incisional surgeries performed at all surgical locations by Mass. Eye and Ear Glaucoma Consultation Service are trabeculectomy and tube shunt surgery. The Mass. Eye and Ear Infectious Disease Service tracks all cases of infections after ocular procedures performed at Mass. Eye and Ear or at any of its affiliates.

During the 2014 calendar year, the Glaucoma Consultation Service performed a total of 316 trabeculectomy and tube shunt surgeries. These surgeries included trabeculectomy (with or without previous scarring) on 128 eyes, and tube shunt surgeries (primary or revision) on 188 eyes. These procedures may have been combined with other procedures, such as cataract extraction or keratoprosthesis surgery. No cases of endophthalmitis were reported within 3 months after the surgery, and similar rates have been reported since data collection began in calendar year 2010.

With regard to trabeculectomy and tube shunt infection rates, the optimum goal is to achieve an infection rate of 0% per year. A review of the literature suggests that trabeculectomy and tube shunt infection rates range from 0.12% to 8.33%.1


Glucoma is a group of disorders that affect the optic nerve, which transmits image signals from the retina to the brain. In glaucoma, damage to the optic nerve results in vision loss. The main risk factor for glaucoma is elevated pressure in the eye. Members of the Mass. Eye and Ear Glaucoma Consultation Service are trained in the most advanced laser and surgical procedures to treat glaucoma. Our specialists treat patients with all forms and stages of glaucoma—even those with advanced disease—and often receive referrals of difficult cases.

For the past five years, the Mass. Eye and Ear Glaucoma Consultation Service has maintained excellent trabeculectomy and tube shunt infection rates compared to international benchmarks.
The Mass. Eye and Ear Glaucoma Consultation Service continues to maintain among the lowest intraoperative complication rates compared to international benchmarks.

Trabeculectomy and Glaucoma Implant Surgery: Intraoperative Complications

Of the 215 cases of trabeculectomy surgery or glaucoma implant surgery performed by the Glaucoma Consultation Service during the 2014 calendar year, 98.6% (212/215) of patients had no intraoperative complications. The cases analyzed include only the trabeculectomy or implant surgeries that were not combined with cataract surgery, secondary lens implantation, or keratoprosthesis procedures. Similar results were reported for calendar years 2010, 2011, 2012, and 2013, during which time 95.5% (234/245), 99.6% (269/270), 97.2% (314/323), and 98.6% (214/217) of patients had no intraoperative complications, respectively. These results are also consistent with an earlier 24-month period between July 2007 and June 2009, when 97.1% (299/308) of eyes had no intraoperative complications.

Mass. Eye and Ear 2014 complication rates:
- Conjunctival tear/buttonhole: 0.5%
- Hyphema: 0%
- Scleral flap trauma: 0.5%
- Vitreous loss (vitreous prolapse): 0%
- Suprachoroidal hemorrhage: 0%
- Scleral perforation: 0%
- Aqueous misdirection: 0.5%

International benchmarks: 1-5
- Conjunctival tear/buttonhole: 1.1%-3.0%
- Hyphema: 1.0%-8.0%
- Scleral flap trauma: 0.7%
- Vitreous loss (vitreous prolapse): 1.0%
- Suprachoroidal hemorrhage: 0%-3.0%
- Scleral perforation: 0%-3.0%
- Aqueous misdirection: 0.2%-1.0%

The 215 cases evaluated included:
- 65 trabeculectomies without scarring
- 15 trabeculectomies with previous scarring
- 118 primary tube surgeries
- 17 tube revisions

References:
Trabeculectomy is the gold-standard incisional surgery for glaucoma patients who require surgery. In this analysis, we included only mitomycin C trabeculectomies that were not combined with cataract surgery, secondary lens implantation, or keratoprosthesis procedures. There were 74 mitomycin C trabeculectomy surgeries (with or without scarring) performed by the Glaucoma Consultation Service for the 2014 calendar year at all surgical locations. Reoperation rates were calculated at the one-month and six-month postoperative time periods. Reoperations were defined as glaucoma procedures required for further intraocular pressure lowering (i.e., repeat trabeculectomy, tube shunt surgery, diode cyclophotocoagulation). Five patients were lost to follow up at the six-month time period.

In the Mass. Eye and Ear Glaucoma Consultation Service, the reoperation rate for mitomycin C trabeculectomy surgery was 0% at one month (out of 74 total procedures) and 5.8% at six months (one bleb revision, one diode cyclophotocoagulation procedure, one repeat trabeculectomy, and one tube shunt surgery in 69 patients available for follow up). To the best of our knowledge, published data on one- and six-month reoperation rates are lacking; thus, our rates are good internal benchmarks to continue to follow.
Preoperative and postoperative intraocular pressure (IOP) measurements were taken using the Tono-Pen (Reichert, Buffalo, NY) prior to the laser procedure and within one hour of the conclusion of the laser procedure. For this analysis, if multiple pressure readings were taken, the average pressure reading was used when calculating the IOP difference (postoperative minus preoperative). All measurements were taken by a certified ophthalmic technician. All patients received either brimonidine or apraclonidine 0.5% before the laser procedure and prednisolone 1% after the procedure.

During calendar year 2014, the Glaucoma Consultation Service performed anterior segment laser procedures on 765 eyes. Of the 765 eyes, this analysis includes the 591 eyes that had laser peripheral iridotomies (254), capsulotomies (46) and laser trabeculoplasties (291). Of the 291 laser trabeculoplasties, 58 were argon laser trabeculoplasties (ALT) and 233 were selective laser trabeculoplasties (SLT).

### Preoperative and Postoperative IOP Spikes

<table>
<thead>
<tr>
<th></th>
<th>≥5 mm Hg</th>
<th>≥10 mm Hg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser Peripheral Iridotomy:</td>
<td>24.0%</td>
<td>4.7%</td>
</tr>
<tr>
<td>Capsulotomy:</td>
<td>8.7%</td>
<td>0%</td>
</tr>
<tr>
<td>Laser Trabeculoplasty:</td>
<td>21.3%</td>
<td>5.2%</td>
</tr>
<tr>
<td>Overall:</td>
<td>21.5%</td>
<td>4.6%</td>
</tr>
</tbody>
</table>

**References:**
Refractive surgery, commonly known as laser vision correction, is a term given to surgical procedures designed to correct certain visual problems such as myopia (nearsightedness), hyperopia (farsightedness), and astigmatism. The Mass. Eye and Ear Cornea and Refractive Surgery Service offers a number of refractive procedures, the most common of which are laser-assisted in situ keratomileusis (LASIK) and photorefractive keratectomy (PRK).

During the 2014 calendar year, 197 of the 250 eyes that had LASIK surgery had sufficient follow-up data for analysis. Sufficient follow-up was defined as at least one month for myopia, and at least three months for hyperopia.

In calendar year 2014, the overall LASIK success rate for achieving within 0.5 diopters of target refraction for myopia and hyperopia was 87.3% (172/197 eyes).

For the past six years, the Mass. Eye and Ear Cornea and Refractive Surgery Service has consistently exceeded international benchmarks for successful LASIK surgery for myopia.

References:
The Mass. Eye and Ear Cornea and Refractive Surgery Service continues to maintain a high overall success rate for LASIK surgery for myopia.

Refractive Surgery — LASIK for Different Degrees of Myopia: Achieving Target Refraction (Spherical Equivalent)

In calendar year 2014, 165 of the 214 eyes had LASIK surgery for myopia, and the success rates based on the degree of myopia are graphed here. LASIK for low myopia was performed on 56 eyes, and of these, 91.1% (51/56 eyes) were successful. For the 93 eyes with moderate myopia, 89.2% (83/93 eyes) were successful; and for the 16 eyes with high myopia, 81.3% (13/16 eyes) achieved within 0.5 diopters of target refraction at one month follow-up.

Similar results were reported for the 2010, 2011, 2012, and 2013 calendar years, during which time the success rate for low myopia was 91.5% (86/94 eyes), 97.3% (71/73 eyes), 90.4% (75/83 eyes), and 95% (76/80 eyes), respectively. Moderate myopia success rates were consistent for 2010, 2011, 2012, and 2013 with 85.4% (105/123 eyes), 82.1% (128/156 eyes), 91.2% (145/159 eyes), and 87.9% (102/116 eyes), respectively. Results for LASIK for high myopia ranged between 80% (28/35 eyes) in 2010, 96.8% (30/31 eyes) in 2011, 75.9% (22/29 eyes) in 2012, and 81.3% (13/16 eyes) in 2013. These results are also consistent with the 12-month period between July 2008 and June 2009, which had success rates for low, moderate and high myopia of 86.1% (93/108 eyes), 87.8% (145/165), and 81.3% (13/16 eyes), respectively.
Refractive Surgery — LASIK for Hyperopia:
Achieving Target Refraction (Spherical Equivalent)

Of the 36 eyes that had LASIK surgery for hyperopia during the 2014 calendar year, 32 had three months or more of follow-up data for analysis. The overall 2014 LASIK success rate for achieving within 0.5 diopters of target refraction was 78.1% (25/32 eyes) for hyperopia.

A review of the literature suggests that the success rate for achieving within 0.5 diopters of the intended target correction after LASIK for hyperopia ranges between 66.7% and 91%. 1-3


For the past six years, the Mass. Eye and Ear Cornea and Refractive Surgery Service has consistently met the international benchmarks for successful LASIK surgery for hyperopia.

Refractive Surgery — LASIK:
Enhancement/Retreatment Rates at Six Months Follow-up

Of the 197 eyes that had LASIK surgery for myopia or hyperopia during the 2014 calendar year, 6.1% (12/197) had an enhancement/retreatment procedure within six months. Similar results have been reported since calendar year 2010, when data collection for enhancement/retreatment rates began.

LASIK retreatment rates of between 3.8% and 29.4% have been reported in the literature. 1-3


For the past five years, the Mass. Eye and Ear Cornea and Refractive Surgery Service has maintained low enhancement/retreatment rates when compared to international benchmarks.
Cornea Surgery: Keratoprosthesis (KPro)

The Boston Keratoprosthesis (KPro) is an artificial cornea developed at Mass. Eye and Ear by Claes Dohlman, M.D., Ph.D. and colleagues. Dr. Dohlman is former Chief of Ophthalmology at Mass. Eye and Ear and Chair of the Department of Ophthalmology at Harvard Medical School. Dr. Dohlman is currently Emeritus Professor of Ophthalmology at Harvard Medical School.

In development since the 1960s, the KPro received FDA clearance in 1992 and European Conformity (CE) mark approval in 2014. It is the most commonly used artificial cornea in the world with more than 11,000 implantations to date. The KPro is reserved for patients blinded by corneal disease and for whom a standard corneal transplant is not a viable option.


Keratoprosthesis Surgery: Surgical Indications

<table>
<thead>
<tr>
<th>Indication</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failed Graft</td>
<td>52.9%</td>
</tr>
<tr>
<td>Aniridic Keratopathy</td>
<td>11.8%</td>
</tr>
<tr>
<td>Hypotony and Corneal Edema</td>
<td>5.9%</td>
</tr>
<tr>
<td>Corneal Neovascularization and Scarring</td>
<td>29.4%</td>
</tr>
</tbody>
</table>

Twenty-seven patients received the type 1 Boston Keratoprosthesis (KPro) during calendar year 2014. Of these 27 patients, 17 (63.0%) received a KPro for the first time and are included in this analysis. Similar data were reported for calendar year 2013, during which time 37 patients received a type 1 KPro, with 29 of them having a primary type 1 KPro with at least three months of follow-up data.

Indications for KPro surgery included failed corneal grafts (9/17, 52.9%), corneal neovascularization and scarring (5/17, 29.4%), aniridic keratopathy (2/17, 11.8%), and hypotony and corneal edema (1/17, 5.9%). Seven patients (7/17, 41.2%) received the KPro as a primary procedure. One aniridic eye had a prior failed graft but was classified only in the aniridic keratopathy category. Corneal neovascularization and scarring were present in one eye from Stevens-Johnson syndrome, and in another eye due to herpes zoster.
During calendar year 2014, 17 patients underwent primary type 1 Boston Keratoprosthesis (KPro) surgery for the first time and had at least three months of follow-up data available for analysis. Of these 17 patients, 13 (76.5%) achieved 20/200 vision or better at any point within the three-month postoperative period or beyond. This is comparable to national benchmarks of 56% to 89% reported in the literature.1-3

Four patients did not achieve postoperative vision of 20/200 or better, and in each case the visual prognosis was limited due to pre-existing severe retinal disease or advanced glaucoma.


20/200 or better

Keratoprosthesis Surgery:
Visual Outcomes

Keratoprosthesis Surgery:
Retention Rates

Of the 17 primary type 1 Boston Keratoprosthesis (KPro) surgeries in calendar year 2014 for which three months of follow-up data were available, 100% of patients retained the KPro at three months. Similar results (100% KPro retention at three months) were reported for calendar years 2011, 2012, and 2013. Per the literature, expected retention rates range from 90.5% to 95% of patients.1-2

Cornea Surgery: Penetrating Keratoplasty

The photos illustrate the before and after of an eye that underwent penetrating keratoplasty (PK) for pseudomonas keratitis in a prior radial keratotomy incision.

Photo courtesy of James Chodosh, M.D., M.P.H.

Cornea Surgery: Distribution of Full-Thickness and Partial-Thickness Keratoplasty

During the 2014 calendar year, the Mass. Eye and Ear Cornea Service performed 258 keratoplasty procedures; of these, 122 (47.3%) were full-thickness penetrating keratoplasty (PK) procedures, and 136 (52.7%) were partial-thickness lamellar keratoplasties. The distribution analysis excluded 39 PKs that were done in combination with retinal, glaucoma, or keratoprosthesis (KPro) procedures, as well as 26 therapeutic PKs done for active infection or non-healing ulcers. This left 57 PKs for inclusion in the distribution analysis compared to 136 partial-thickness procedures: 106 Descemet’s stripping endothelial keratoplasties (DSEKs), 14 Descemet’s membrane endothelial keratoplasties (DMEKs), and 16 deep anterior lamellar keratoplasties (DALKs).

N = 193

Deep Anterior Lamellar Keratoplasty (DALK) 8.3%

Penetrating Keratoplasty (PK) 29.5%

Descemet’s Membrane Endothelial Keratoplasty (DMEK) 5.4%

Descemet’s Stripping Endothelial Keratoplasty (DSEK) 7.3%

Descemet’s Membrane Endothelial Keratoplasty (DMEK) 7.3%

Tracked for the first time in calendar year 2014, the novel Descemet’s membrane endothelial keratoplasty (DMEK) procedure is now increasingly performed at Mass. Eye and Ear for the treatment of corneal endothelial disorders.

Tracked for the first time in calendar year 2014, the novel Descemet’s membrane endothelial keratoplasty (DMEK) procedure is now increasingly performed at Mass. Eye and Ear for the treatment of corneal endothelial disorders.
Corneal transplant surgery provides clear cornea tissue from a donor to replace diseased host tissue.

During the 2014 calendar year, 122 full-thickness penetrating keratoplasty (PK) procedures were performed by the Mass. Eye and Ear Cornea and Refractive Surgery Service. The current analysis includes only elective PKs that had up to three months of follow-up data available and were not done in combination with retinal, glaucoma, or keratoprosthesis (KPro) procedures. This left 55 (45.1%) elective PKs for analysis for calendar year 2014. These 55 elective PKs included first-time grafts in uninflamed host beds, as well as PKs performed in eyes at high risk of rejection, including eyes with extensive corneal neovascularization and/or a failed corneal graft.

Indications for elective PKs included failed corneal graft (30/55, 54.5%), keratoconus (11/55, 20%), corneal scar (8/55, 14.5%), bullous keratopathy (2/55, 3.6%), corneal edema (2/55, 3.6%), and corneal dystrophy (2/55, 3.6%). One eye with keratoconus also had Fuch’s endothelial dystrophy and was classified under keratoconus.

Of 122 full-thickness PKs performed in 2014, 55 were elective procedures with up to three months follow-up data and included in the analysis. Of these elective PKs, 51 (92.7%) achieved surgical success, which is defined as a graft at three months follow-up with minimal to no clinical edema and with sufficient clarity to permit the examiner to have an unencumbered view of the interior of the eye, including iris details.

Oculoplastic Surgery: Dacryocystorhinostomy (DCR) Lacrimal Bypass Surgery

During the 2014 calendar year, the Mass. Eye and Ear Ophthalmic Plastic Surgery Service performed external dacryocystorhinostomy (Ex-DCR) procedures on 66 eyes of 62 patients. Twelve eyes of 11 patients were excluded for pre-existing ocular conditions, such as Wegener’s granulomatosis, sarcoidosis, cancer (e.g., lymphoma), benign tumors, post-traumatic lacrimal obstruction, congenital cases, and cases with sinus disease (e.g., sinusitis). This analysis includes the remaining 54 eyes of 51 patients who underwent primary Ex-DCR in 2014 for primary acquired nasolacrimal duct obstruction (NLDO). Of these eyes, none (0%) required a second procedure within six months in order to achieve surgical success. Similar results were reported for calendar year 2012, during which time there were no reoperations within six months of primary Ex-DCR.

Ex-DCR is a common surgical method for NLDO. A review of the literature suggests that 7.8% to 12.5% of patients require reoperation following primary external DCR for primary acquired NLDO.

References:
**Oculoplastic Surgery:**
**Reoperation Rate for Endoscopic Dacryocystorhinostomy (En-DCR) Surgery at Six Months Follow-up**

During the 2014 calendar year, the Mass. Eye and Ear Ophthalmic Plastic Surgery Service performed endoscopic dacryocystorhinostomy (En-DCR) procedures on 45 eyes of 36 patients. Seventeen eyes of 15 patients were excluded for pre-existing ocular conditions, such as Wegener's granulomatosis, sarcoidosis, cancer (e.g., lymphoma), benign tumors, post-traumatic lacrimal obstruction, and congenital cases. Procedures involving laser DCR were also excluded. This analysis includes the remaining 28 eyes of 21 patients who underwent primary En-DCR in 2014 for primary acquired nasolacrimal duct obstruction (NLDO). Of these eyes, 7.1% (2/28) required a second procedure within six months to achieve surgical success.

A review of the literature suggests that 2% to 11% of patients who undergo primary En-DCR for primary acquired NLDO require a revision.

**References:**

**Oculoplastic Surgery:**
**Reoperation Rate for Lid Surgeries at Six Months Follow-up**

During the 2014 calendar year, the Mass. Eye and Ear Ophthalmic Plastic Surgery Service performed upper lid blepharoplasty and/or ptosis repair surgeries on 540 eyelids in 305 patients. These lid surgeries included (but were not limited to) functional eyelid surgery, cosmetic eyelid surgery, and surgeries on patients with other medical conditions, such as neurogenic ptosis, myogenic ptosis, congenital ptosis, and thyroid eye disease. Of these 540 eyelids, only 2.8% (15/540) required a second procedure within six months in order to achieve surgical success. Similar results were reported for calendar years 2011, 2012, and 2013, during which time 2.6% (11/416), 1.7% (8/467), and 3.1% (18/574) of eyelids required a second procedure within six months, respectively. These results are also consistent with an earlier 12-month period from March 2008 to February 2009 when 2.9% (10/343) of eyelids required a reoperation.

A review of the literature suggests that reoperation rates after eyelid surgery range from 2.6% to 8.7%.

**References:**
Recession and resection procedures are most commonly performed for horizontal misalignment. Other surgeries less frequently performed include loop myopexies and transpositions.

Pediatric and Adult Strabismus Surgery

Strabismus surgery, the most commonly performed ophthalmic procedure in children, is offered to adults as well. Surgery is performed for a variety of indications, including restoration of binocular vision, restitution of normal eye contact (reconstructive), treatment of double vision, or reduction of anomalous head posture (torticollis). Since the desired surgical outcome depends on the primary indication of surgery, we developed a unique goal-directed methodology to assess surgical outcomes. This approach provides the most clinically relevant appraisal of our outcomes. The model excludes no patient based on diagnosis or procedure performed, and therefore facilitates stratification based on the presence or absence of risk factors (ophthalmic or systemic) that might impact results. The tables on the following pages summarize the criteria, and the figures that follow illustrate our outcomes using this goal-directed methodology. These reported pediatric and adult strabismus surgery outcomes include procedures done at all surgical locations.


Our goal-directed methodology provides a clinically relevant appraisal of strabismus surgery outcomes. Reported results were monitored two to six months after strabismus surgery was performed.
Pediatric and Adult Strabismus Surgery: Outcomes Criteria

### 1. Goal—Binocular Potential for Esotropia (ET)

<table>
<thead>
<tr>
<th>Subjective</th>
<th>Distance angle</th>
<th>Near angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>ET≤10° or XT≤5°</td>
<td>No XT, any ET</td>
</tr>
<tr>
<td>Good</td>
<td>10°&lt; ET≤15° or 5°&lt; XT≤10°</td>
<td>X(T)≤10° any ET</td>
</tr>
<tr>
<td>Poor</td>
<td>Recommend re-operation (horizontal)</td>
<td>ET&gt;15 or XT&gt;10</td>
</tr>
</tbody>
</table>

1. Order of preference for angle used: > simultaneous prism-and-cover test (SPCT) > alternate prism-and-cover test (APCT) > Krimsky

### 2. Goal—Binocular Potential for Exotropia (XT)

<table>
<thead>
<tr>
<th>Sensory</th>
<th>Distance angle</th>
<th>Near angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>Near stereo-acuity &lt;2 octaves worsened from pre-op and not diminished to nil²</td>
<td>XT&lt;10° or ET&lt;6° or ET&lt;6°</td>
</tr>
<tr>
<td>Good</td>
<td>Near stereo-acuity &lt;2 octaves worsened from pre-op and not diminished to nil²</td>
<td>10°≤XT&lt;15° or 6°≤ET≤10° or 6°≤ET≤10°</td>
</tr>
<tr>
<td>Poor</td>
<td>Recommend re-operation (horizontal)</td>
<td>XT≥15° or ET≥10°</td>
</tr>
</tbody>
</table>

1. Order of preference for angle used: > simultaneous prism-and-cover test (SPCT) > alternate prism-and-cover test (APCT) > Krimsky

2. Accept Worth-4-dot test (W4D) fusion if stereo-acuity data not available

### 3. Goal—Reconstructive (ET or XT)

<table>
<thead>
<tr>
<th>Subjective</th>
<th>Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent²</td>
<td>ET or XT≤10°</td>
</tr>
<tr>
<td>Good</td>
<td>10°&lt;ET or XT≤15°</td>
</tr>
<tr>
<td>Poor</td>
<td>Recommend re-operation (horizontal)</td>
</tr>
</tbody>
</table>

1. Order of preference for angle used: Krimsky > simultaneous prism-and-cover test (SPCT) > alternate prism-and-cover test (APCT)

2. Near angle (unless stated goal of distance angle)

3. Ignore coexisting vertical deviation
Pediatric and Adult Strabismus Surgery:
Outcomes Criteria

4. Goal—Resolution of Diplopia (ET or XT)

Subjective

<table>
<thead>
<tr>
<th>Objective</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>No diplopia in primary$^1$</td>
</tr>
<tr>
<td>Good</td>
<td>Diplopia controlled with prism</td>
</tr>
<tr>
<td>Poor</td>
<td>Recommend re-operation for diplopia and/or diplopia not comfortably controlled with prism correction</td>
</tr>
</tbody>
</table>

$^1$ At distance and near but may have rare diplopia in primary, or diplopia away from primary
$^2$ Preexisting vertical alignment controlled with prism does not affect result if no increase
$^3$ New vertical alignment requiring prism cannot exceed “good” outcome

5. Goal—Reduction of Torticollis (ET or XT)

Subjective$^1$ | Torticollis$^2$
---|---
Excellent | $\leq 8^\circ$
Good | $>8^\circ \leq 12^\circ$
Poor | Recommend re-operation for diplopia or torticollis $>12^\circ$

$^1$ Subjective category trumps the other categories
$^2$ Distance (unless stated goal of near)
Of the 106 patients who underwent surgical remediation of exotropia in 2014, 31 patients had surgery to restore binocular vision, 70 for reconstructive purposes, 3 to resolve diplopia, and 2 to resolved uncomplicated torticollis. Exotropia patients are grouped according to the primary goal for surgery.

The figure represents outcomes for exotropia surgery performed by ophthalmologists with joint appointments at the Mass. Eye and Ear Pediatric Ophthalmology and Strabismus Service and Boston Children’s Hospital from calendar years 2012, 2013 and 2014. Outcomes were graded as excellent, good, or poor, based on criteria determined by the primary goal of surgery. The results were then secondarily stratified based on the presence or absence of associated risk factors.

Of the 106 patients with exotropia who underwent strabismus surgery in 2014, 51 patients had associated risk factors. Of the 55 patients with no associated risk factors, 2 had surgery to resolve uncomplicated torticollis.

This figure presents outcomes for exotropia surgery in patients with or without associated risk factors. Risk factors included the following: bilateral vision limitation (e.g., albinism), conditions resulting in hyper- or hypotonia, craniosynostosis or craniofacial anomalies, 3rd nerve palsy, 4th nerve palsy, prior strabismus surgery, Duane syndrome, prior surgery for retinal detachment, Graves’ orbitopathy, antecedent orbital trauma with or without orbital fracture, congenital fibrosis of the extraocular muscles and simultaneous surgery for nystagmus or vertical strabismus.
Of 127 patients with esotropia who had strabismus surgery in 2014, 46 underwent surgery to restore binocular vision, 43 for reconstructive goals, 28 to resolve diplopia, and 10 to resolve torticollis.

Of the 127 patients with esotropia who underwent strabismus surgery in 2014, 64 patients had associated risk factors. Of 10 surgeries performed to resolve torticollis, 4 had associated risk factors.

These graphs illustrate outcomes of esotropia surgery performed by ophthalmologists with joint appointments at the Mass. Eye and Ear Pediatric Ophthalmology and Strabismus Service and Boston Children’s Hospital during calendar years 2012, 2013 and 2014. Outcomes were graded as excellent, good, or poor, based on criteria determined by the primary goal of surgery. The results were then secondarily stratified based on the presence or absence of associated risk factors.

Of the 127 patients with esotropia who underwent strabismus surgery in 2014, 64 patients had associated risk factors. Of 10 surgeries performed to resolve torticollis, 4 had associated risk factors.

This figure presents outcomes for esotropia surgery in patients with or without associated risk factors. Risk factors included the following: prior strabismus surgery, bilateral vision limitation (e.g., albinism), systemic conditions resulting in hyper- or hypotonia, craniosynostosis or craniofacial anomalies, Graves’ orbitopathy, antecedent orbital trauma with or without orbital fracture, prior surgery for retinal detachment, heavy eye syndrome, Brown syndrome, Duane syndrome, 6th nerve palsy, preoperative esotropia ≥ 50 prism dioptries, congenital fibrosis of the extraocular muscles, and simultaneous surgery for nystagmus or vertical strabismus.
Of the 578 procedures performed, there were no scleral perforations.

Scleral perforation is a major complication of strabismus surgery, typically occurring during the reattachment of the eye muscles to the globe. An associated retinal hole can give rise to retinal detachment in some cases.

The following figure demonstrates the scleral perforation rate for strabismus surgery performed by ophthalmologists with joint appointments at the Mass. Eye and Ear Pediatric Ophthalmology and Strabismus Service and Boston Children’s Hospital during calendar year 2014.


Intra- or extraocular surgery may be complicated by postoperative infection. The following figure demonstrates the postoperative infection rates for strabismus, pediatric cataract, and pediatric ptosis surgeries performed by ophthalmologists with joint appointments at the Mass. Eye and Ear Pediatric Ophthalmology and Strabismus Service and Boston Children’s Hospital during calendar year 2014.

The types of infection after strabismus surgery that were included were endophthalmitis, sub-Tenon’s space abscess, subconjunctival abscess, and cellulitis. In calendar year 2014, one of the 578 strabismus procedures was complicated by a suture abscess. In calendar year 2013, three of the 350 strabismus procedures were complicated by orbital cellulitis. In calendar year 2013, three of the 350 strabismus procedures were complicated by a suture abscess. In calendar year 2013, three of the 350 strabismus procedures were complicated by orbital cellulitis.

The surgical volume of the Mass. Eye and Ear Neuro-Ophthalmology Service has increased from calendar year 2012 to calendar year 2014.

Neuro-Ophthalmology Service: Demographics of Adult Strabismus Surgery Patients

During the 2014 calendar year, the Mass. Eye and Ear Neuro-Ophthalmology Service performed strabismus surgeries on 120 patients. The patients included 72 (60%) females and 48 (40%) males. Similar results were reported for calendar years 2012 and 2013, during which time there were 59 (53.6%) females and 51 (46.4%) males among a total of 110 patients for calendar year 2013, and 57 (51.8%) females and 53 (48.2%) males among a total of 110 patients for calendar year 2012.

Neuro-Ophthalmology Service: Preoperative Symptoms in Adult Strabismus Surgery Patients

During the 2014 calendar year, the Mass. Eye and Ear Neuro-Ophthalmology Service performed strabismus surgeries on 120 patients. The majority of patients (84.2% or 101 patients) had diplopia preoperatively, while the minority of patients (15.8% or 19 patients) did not have diplopia. Diplopia was also a common pre-operative symptom in prior calendar years 2013 (78.2% or 86 of 110 patients) and 2012 (70% or 77 of 110 patients).

Diplopia is one of the most common indications for surgical intervention at the Mass. Eye and Ear Neuro-Ophthalmology Service.
The current analysis depicts the etiologies associated with adult strabismus surgery for calendar year 2014. Of the 120 strabismus surgery cases, the most common etiologies were congenital, idiopathic, or traumatic strabismus (61.7% or 74 patients). In this cohort, thyroid eye disease was a common cause (14.2% or 17 patients). Other etiologies included 4th nerve palsy (12.5% or 15 patients), 6th nerve palsy (4.2% or 5 patients) and 3rd nerve palsy (4.2% or 5 patients). Multiple cranial neuropathies were seen in 1.6% or 2 patients. One patient (0.8%) had skew deviation, and one patient (0.8%) had cerebellar degeneration.

In calendar year 2014, the Mass. Eye and Ear Neuro-Ophthalmology Service performed surgeries on a total of 254 muscles in 120 patients (average number of muscles per patient was 2.12). Of these 120 surgeries, 112 patients (93.3%) had the adjustable technique and 8 patients (6.7%) had a non-adjustable procedure that consisted of an inferior oblique myectomy. Of the 112 patients who underwent an adjustable procedure, 74 patients (66.1%) needed an adjustment in the immediate postoperative period 2-3 hours following surgery.
After strabismus surgery at the Mass. Eye and Ear Neuro-Ophthalmology Service, most patients (92%) were without diplopia postoperatively, with or without prism glasses.

In calendar year 2014, the Mass. Eye and Ear Neuro-Ophthalmology Service performed surgeries on a total of 120 patients. Pre-operatively, 19 patients (15.8%) were without diplopia, and 101 patients (84.2%) had diplopia. Postoperatively, 86.1% patients who had diplopia (87 of 101 patients) were without diplopia in primary position after a single surgery. In addition, 7.9% (8 of 101 patients) required a second surgery. The remaining 5.9% (6 of 101 patients) who had diplopia prior to surgery were without diplopia in primary position with prism glasses after a single surgery.

The Mass. Eye and Ear Ocular Immunology and Uveitis Service saw a total of 3,553 patients over 7,033 office visits during the 2014 calendar year.

Of the 3,553 patients seen in 2014 by the Ocular Immunology and Uveitis Service, 684 patients (19.3%) were treated for ocular inflammation with some form of systemic medication, ranging from prescription oral nonsteroidal anti-inflammatory drugs (NSAIDs) (e.g., ibuprofen, naproxen) to oral corticosteroids (i.e., prednisone) to immunosuppressive agents (e.g., methotrexate, mycophenolate mofetil).

* Data reported for the 2012 and 2014 calendar years include all patients seen by the Ocular Immunology and Uveitis Service at any Mass. Eye and Ear location. For calendar year 2013 data, the graphed data depict only patients who were seen at Mass. Eye and Ear, Main Campus, in Boston.

Treatment for uveitis (i.e., inflammation inside the eye) and other ocular inflammatory conditions requires a multidisciplinary approach that involves internal medicine and ophthalmology. At the Mass. Eye and Ear Ocular Immunology and Uveitis Service, patients are treated with a range of therapies, including topical eye drops, prescription NSAIDs, and systemic immunosuppressive medications. In general, the use of systemic immunomodulatory therapy is an indicator of increased disease severity.
During the 2014 calendar year, out of 547 total Vision Rehab patients, 54 (9.9%) were enrolled in a prospective database and completed two questionnaires both prior to and after rehabilitation. Patient scores on both the National Eye Institute Visual Functioning Questionnaire (NEI VFQ-25) and the Impact of Vision Impairment (IVI) questionnaire indicate that many aspects of daily life and patients’ adjustment to vision loss are positively impacted by comprehensive vision rehabilitation.

Mean scores of four NEI VFQ-25 subscales are displayed above with 100 being the best reported function. Changes post-rehabilitation are consistent with previously reported studies of vision rehabilitation outcomes.¹,²,³

References:

Patients reported improvement on all NEI VFQ-25 subscales with greatest improvement for mental health.

Patients reported improvement on all IVI subscales with greatest improvement for mobility and well-being.
The Mass. Eye and Ear Vision Rehabilitation Service continues to offer multidisciplinary Comprehensive Vision Rehabilitation tailored to each patient’s unique goals. Interventions address reading, difficulties with activities of daily living, patient safety, continued participation in activities despite vision loss, and the psychosocial adjustment to low vision. During 2014, 253 patients completed a six-question survey after their initial consultation.

99% percent of patients treated by the Vision Rehabilitation Service rated the quality of service as either “Excellent” or “Above Average.”

Ninety-eight percent of patients reported that the explanation of their rehabilitation options was either “Excellent” or “Above Average.”
Ninety-six percent of patients rated the interactions with staff as “Excellent” and 4% rated the interactions as “Above Average.” No patients reported that their interactions were “Average” or “Poor.”

Based on their own experiences, 100% of patients said they would recommend the Mass. Eye and Ear Vision Rehabilitation Service to friends or family.
Ophthalmology Medical Staff and Practice Locations

<table>
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<th>Locations</th>
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Tel: 617-573-3202 |
| **Mass. Eye and Ear, East Bridgewater**  
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| **Mass. Eye and Ear, Retina Consultants**  
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Eric A. Pierce, MD, PhD, Service Director

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Lucy H. Y. Young, MD, PhD

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