MASSACHUSETTS EYE AND EAR

Quality and Outcomes

Department of Ophthalmology

2018

Photo by Suzanne Day.

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Photo by Garyfallia Pagonis.

Leading the way in making outcomes data publicly available...

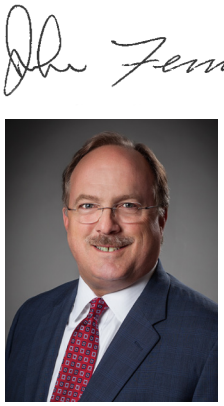
Dear Colleagues in Health Care,

Since 2010, Massachusetts Eye and Ear has led the medical community in the development and implementation of outcomes measures for the field of Ophthalmology, and we have consistently reported on these measures in our *Quality and Outcomes* annual report.

In publishing these reports year after year, we have defined important measures for the ophthalmology field that include the full spectrum of care that we provide — from routine to very complex procedures. By sharing our clinical data, we hope to set standards of transparency and accountability in ophthalmology and inspire other centers around the country to engage in similar public reporting.

This report reflects the meticulous work of many contributors. We thank Dr. Alice Lorch, Chief Quality Officer for Ophthalmology, for her leadership in this project, as well as her team of faculty, administrators and trainees. We also want to thank Dr. Matthew Gardiner, Associate Director of Quality for Ophthalmology, as well as the clinicians, technicians, nurses and other staff members at Mass. Eye and Ear who work hard every day to provide the highest quality care to our patients. A special note of thanks to former Chief Quality Officer, Dr. Teresa Chen, whose decade of leadership in this initiative helped to establish Mass. Eye and Ear as an international leader in quality and outcomes reporting.

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



John Fernandez
President
Massachusetts
Eye and Ear

Photo by John Earle.

Joan W. Miller, MD
David Glendenning Cogan
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Harvard Medical School

About the Quality and Outcomes Program

Photo by Garyfallia Pagonis.

Since our founding in 1824, Massachusetts Eye and Ear has been a leader in clinical, educational, and research innovation that has improved ophthalmic care across every subspecialty. One recent success is captured on the cover of this report, which shows Dr. Jason Comander performing the first administration of the newly FDA-approved gene therapy drug, Luxturna®, on a patient at Mass. Eye and Ear. This milestone marked the beginning of a new era in medicine, as it is the first time any FDA-approved gene therapy drug had been given to a patient with an inherited disease.

At Mass. Eye and Ear, we embrace the challenges of complicated disease while also closely monitoring the outcomes of our most common surgical and medical care. We are equally proud of — and committed to — the quality of ophthalmic care that all of our patients receive, whether for an inherited retinal disease or for a routine cataract procedure.

The measures that have grown from our annual *Quality and Outcomes* book over the last decade have established both national benchmarks as well as internal metrics by which we critically monitor our own progress. Quality improvement projects within our department are based on these data analyses. We share the information in this book both to inspire other ophthalmology departments with a template for quality reporting and to inform our patients about their care.

In the Quality Department at Mass. Eye and Ear, our commitment to self-evaluation and transparency using data analysis manifests in many initiatives beyond the *Quality and*

Outcomes book. We closely monitor Patient Safety through an electronic and anonymous reporting system that all employees are encouraged to use. We study our Patient Experience by applying LEAN techniques to improve clinic efficiency as well as by collecting Patient Related Outcomes Measures (PROMs) within our electronic medical record. We introduce the importance of Quality Monitoring and Improvement to our trainees through didactics and participation in quality improvement projects.

This year, Mass. Eye and Ear was selected as one of five academic groups in the United States awarded access to the American Academy of Ophthalmology's IRIS® Registry Database — the country's largest specialty clinical data registry containing clinical benchmarks and practice patterns on nearly 50 million U.S. patients and 200 million patient visits. Under the direction of department chair, Dr. Joan Miller, and me, we are at the forefront of using "big data" for quality improvement and monitoring. Our goal is to partner with the medical community to develop clinical outcomes measures that will improve the patient experience, improve the health of populations, and reduce the cost of healthcare.

This is my first year overseeing the development of the *Quality and Outcomes* book for the Department of Ophthalmology at Mass. Eye and Ear, with the assistance of research assistants Mirjana Nordmann, Ph.D., and Colleen Szypko. Thank you to Dr. Teresa Chen, former Chief Quality Officer (2010-2017), as well as Dr. Matthew Gardiner, Associate Director of Quality for Ophthalmology, for their support. As a Quality team, we are excited by the prospect of expanding the *Quality and Outcomes* book in the coming years. We hope that you find this information useful, and we welcome your comments and feedback.

Alice Lorch

Alice Lorch, MD, MPH
Chief Quality Officer
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Ophthalmology Clinical Leadership in Quality: 2018

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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 medical center for Harvard Ophthalmology, and the hub of its research and teaching facilities, Mass. Eye and Ear encourages multidisciplinary and interdisciplinary pursuits across patient care, research, and education. Seminal contributions to these three mission-critical areas span nearly two hundred years and have shaped the hospital's reputation and success as a national and global center of excellence.

Pivotal to our clinical quality efforts is the use of Partners eCare, a highly integrated health information system. Partners eCare is utilized by a large segment of Harvard Medical School's network of hospitals and affiliates, facilitating quick and easy communication amongst referring physicians and Mass. Eye and Ear's consulting ophthalmologists, otolaryngologists, and radiologists.

2017 Ophthalmology and Otolaryngology Hospital Statistics

(January 1 – December 31, 2017)

Patient Volume

All services at Mass. Eye and Ear locations by faculty and non-faculty physicians.

Outpatient Services*	491,704
Ambulatory Surgery Services	32,717
Inpatient Surgical Services	1,015
Emergency Department Services	20,172
Discharges	1,279
Beds	41
Overall Operating Revenue#	$454,538,656

*All clinic visits, Ambulatory Surgery Services, and Emergency Department Services
#All sites, clinical and non-clinical

Clinical Locations

- Boston - 243 Charles St.*
- Boston - Longwood*
- Braintree
- Concord
- Duxbury
- East Bridgewater*
- Harwich
- Malden*
- Mashpee
- Medford
- Milton
- Newton
- Plainville*
- Providence*
- Quincy
- Stoneham*
- Waltham*
- Wellesley
- Weymouth

*Denotes locations with ophthalmology services.

For more information, visit MassEyeAndEar.org/Locations

Massachusetts Eye and Ear Ophthalmology Department

At the Mass. Eye and Ear/Harvard 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 of Mass. Eye and Ear, Howe Laboratory, and Berman-Gund Laboratory for the Study of Retinal Degenerations
- Accelerating research and discovery through our Harvard Ophthalmology 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 clinicians provide comprehensive and subspecialty care to MGH patients in outpatient, inpatient consultation, surgical, and emergency care settings. Our 24/7 Emergency Department is a regional resource for urgent care and trauma, and our clinicians collaborate in the care of patients with ocular cancers and burns.
- Mass. Eye and Ear's dedicated Same Day Service triages urgent and emergent eye concerns of MGH patients as a less costly, more efficient alternative to Emergency Department care.

Academic Affiliations

Harvard Medical School
Massachusetts General Hospital
Brigham and Women's Hospital
Boston Children's Hospital
Beth Israel Deaconess Medical Center
VA Boston Healthcare System
VA Maine Healthcare System
Cambridge Health Alliance
Aravind Eye Hospital, Madurai, India
Shanghai Eye and ENT Hospital: Fudan University, Shanghai, China
LV Prasad Eye Institute, Hyderabad, India

Brigham and Women's Hospital (BWH)

- Mass. Eye and Ear ophthalmologists provide comprehensive and subspecialty care and inpatient consultations to BWH patients, including 24/7 emergency eye care and trauma coverage.
- BWH patients also receive a full range of ophthalmic care including dedicated Same Day Service, urgent consultation, evaluations and surgery at Mass. Eye and Ear, Longwood, staffed by Mass. Eye and Ear clinicians.

Boston Children's Hospital Ophthalmology Foundation

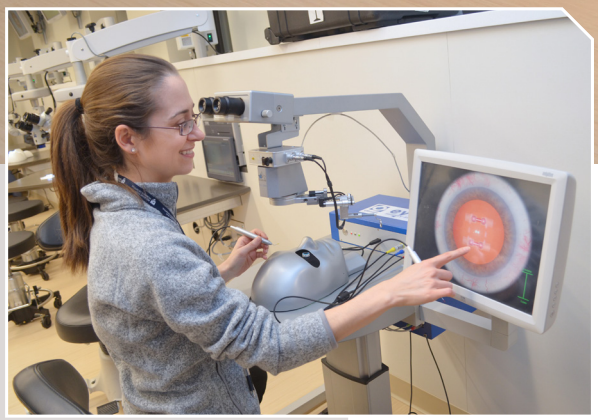
- Boston Children's Hospital clinicians staff the comprehensive pediatric ophthalmology and adult strabismus service at Mass. Eye and Ear and Mass General Hospital, and reassure coverage for retinopathy of prematurity screenings.
- Mass. Eye and Ear ophthalmologists provide subspecialty care in glaucoma, cornea, and pediatric retina surgery at Boston Children's Hospital.

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 de Gunzburg Retinal Imaging Suite offers state-of-the-art spectral domain optical coherence tomography, optical coherence tomography angiography, and swept source optical coherence tomography ultrasound angiography
- Our Inherited Retinal Disorders Service performs evaluations of patients referred for diagnosis, prognosis, genetic counseling, and treatment of retinal degenerative disorders.
- The Ocular Melanoma Center, a premier referral center for the diagnosis and treatment of eye tumors, draws patients from around the world.
- 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.
- The David Glendenning Cogan Laboratory of Ophthalmic Pathology provides enhanced diagnostic services in conjunction with the MGH Surgical Pathology Service.
- The Mass. Eye and Ear Infectious Disease Institute tracks all cases of infections after all procedures performed at Mass. Eye and Ear or at any of its affiliates.
- 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 Mass. Eye and Ear Radiology Department houses a dedicated MRI/CT imaging suite.

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

Photos by Garyfallia Pagonis.



Ophthalmology resident training in the Samuel and Nancy Jo Altschuler Ophthalmology Surgical Training Laboratory.

- 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.
- The Altschuler Surgical Training Laboratory serves as a cornerstone of the surgical training program at Mass. Eye and Ear/Harvard Ophthalmology, and houses state-of-the-art surgical equipment, training machines for vitreoretinal and cataract surgery, a proctor station with a plasma screen, and other technological improvements.
- The Howe Library houses one of the most extensive ophthalmology research collections in the world. The library also belongs to several consortia, including The Francis A. Countway Library of Medicine at Harvard Medical School, and maintains cooperative arrangements with other institutions such as the National Library of Medicine, and Association of Vision Science Libraries.

Mass. Eye and Ear Ophthalmology Key Statistics

(January 1–December 31, 2017)

Subspecialty	Patient Visits
Outpatient Ophthalmology Encounters	
Comprehensive Ophthalmology and Cataract Consultation	51,537
Trauma	543
Cornea	21,455
Optometry	11,875
Ophthalmic Plastic and Reconstructive Surgery	10,665
Glaucoma	26,697
Immunology and Uveitis	7,644
Inherited Retinal Disorders	1,419
Neuro-Ophthalmology	7,350
Retina	46,647
Vision Rehabilitation	1,130
Total Outpatient Ophthalmology Visits	186,962
Emergency Room Visits	
Total Ophthalmology Visits	15,523
Surgical Procedures	
Total Ophthalmology Surgeries	12,890
Total Ophthalmology Laser Procedures	3,762
Refractive Procedures	551
Total Intravitreal Injections	15,492
Total Ophthalmology Procedures	32,695

Data reported throughout the book for 2010, 2011, 2012, 2013, 2014, 2015, 2016, and 2017 represent calendar years. The 2009 data represent 12-month results as noted.

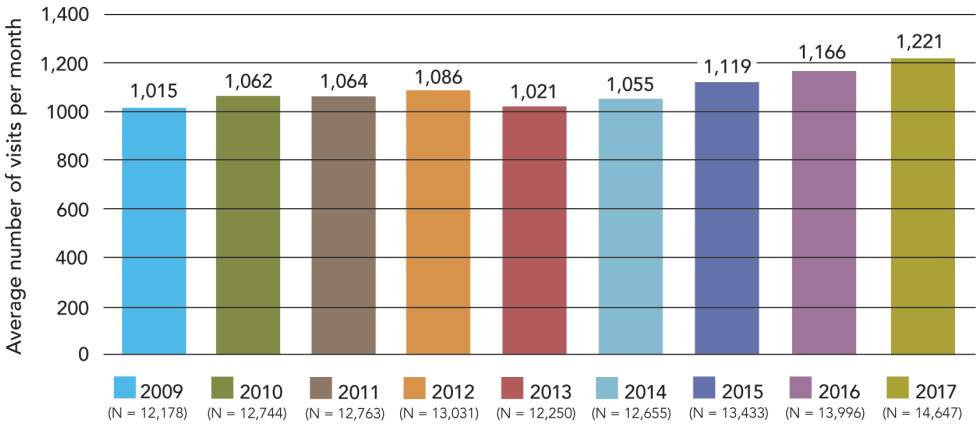
All benchmarks reported reflect the most recent values published in the literature.

Emergency Department

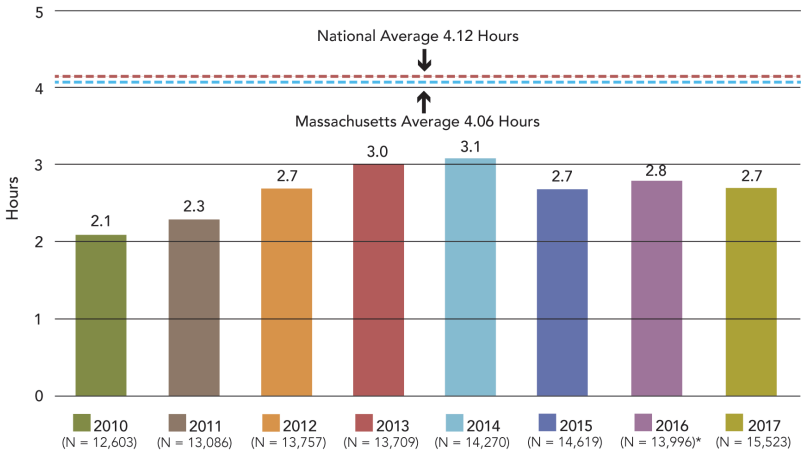
The emergency department at Mass. Eye and Ear provides 24/7 urgent ophthalmic care for the local community and for patients who are referred to Mass. Eye and Ear from throughout the region. The department works closely with Massachusetts General Hospital's emergency department to co-manage and coordinate care for patients with ophthalmic problems.

Ophthalmology Emergency Visits

This bar graph shows the average number of ophthalmology initial encounters seen monthly by the Mass. Eye and Ear Emergency Department across the last nine calendar years.



Ophthalmology Visit Times



For the past eight years, the average ophthalmology visit time in the Mass. Eye and Ear Emergency Department was lower than the average national and state visit times.

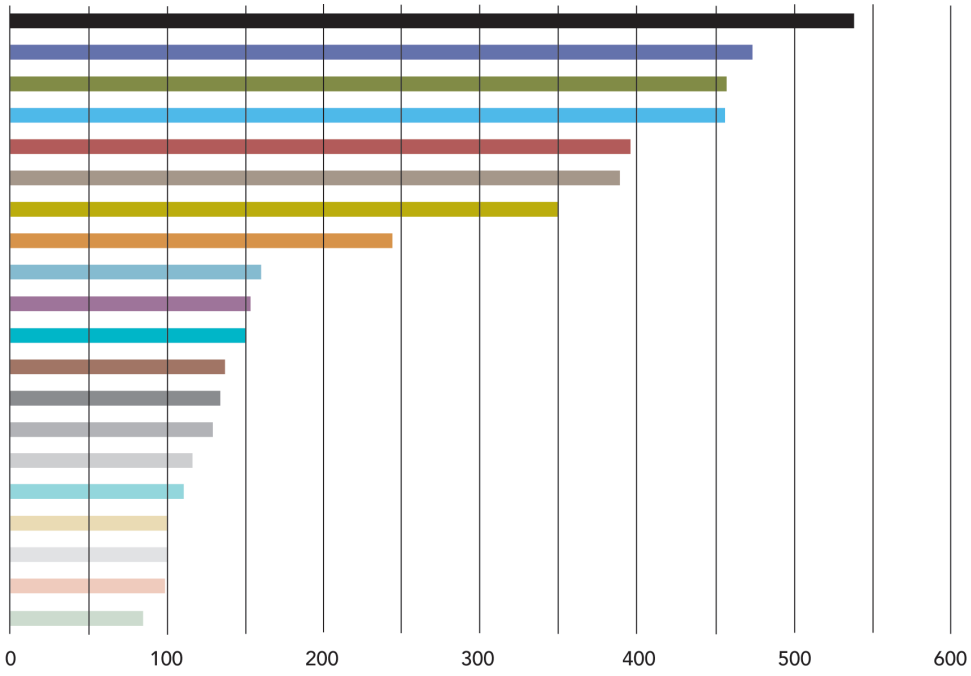
The average ophthalmology visit time in the Mass. Eye and Ear Emergency Department for calendar year 2017 was 2.7 hours. The visit time is defined as the total time from when the patient walked into Mass. Eye and Ear's Emergency Department to when the patient finished the visit with the ophthalmologist. Visit times over 3 standard deviations from the raw mean were considered outliers and were excluded from the final analysis due to suspicion of poor documentation in those cases. 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 calendar year 2016, the graphed data depicts only initial encounters.*

Distribution of Top Twenty Urgent Ophthalmology Diagnoses

During calendar year 2017, there were 14,647 ophthalmic emergency initial encounters to the Mass. Eye and Ear Emergency Department. Of these, 4,750 were associated with urgent diagnoses. The top twenty urgent diagnoses represented 4,358 (29.8%) of the total emergency room initial encounters and are depicted below and ranked according to their frequency.

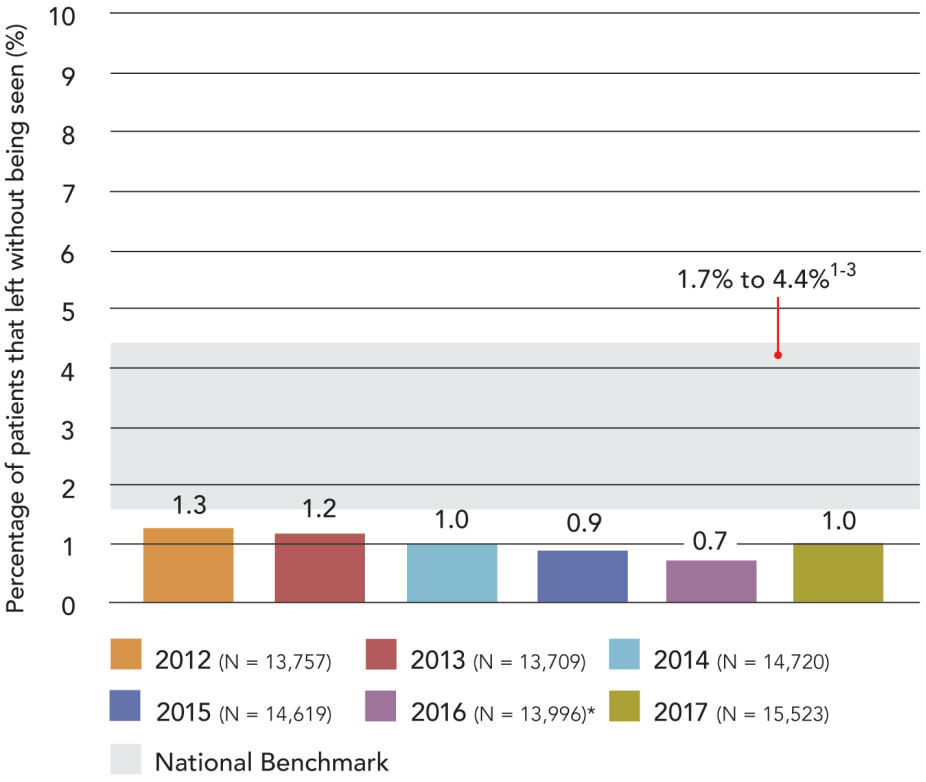
The top five most frequent diagnoses include keratitis, iridocyclitis, corneal foreign body, retinal detachment, and corneal ulcer.



- Keratitis (N = 540)
- Iridocyclitis (N = 474)
- Foreign Body in Cornea (N = 458)
- Retinal Detachment (N = 457)
- Corneal Ulcer (N = 396)
- Glaucoma (N = 389)
- Vitreous Hemorrhage (N = 350)
- Retinal Break (N = 244)
- Scleritis (N = 160)
- Laceration of Eyelid (N = 153)
- Foreign Body on External Eye (N = 150)
- Diplopia (N = 137)
- Retinal Hemorrhage (N = 134)
- Contusion of the Eye (N = 129)
- Orbital Fracture (N = 116)
- Papilledema (N = 111)
- Open Globe (N = 106)
- Abscess of Eyelid (N = 100)
- Vision Field Defect (N = 98)
- Anisocoria (N = 84)

Ophthalmology "Left Without Being Seen" (LWBS) Rate

"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% (160 patients for all 15,523 initial and follow-up ophthalmic emergency encounters) in calendar year 2017. According to a 2009 report by the Society for Academic Emergency Medicine, the national LWBS rate is 1.7%.[1] LWBS rates vary greatly between hospitals; a review of the literature suggests a national range of 1.7% to 4.4%.[1-3]

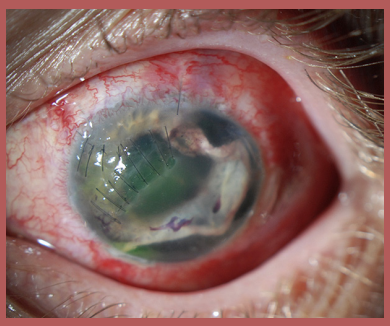


**Data reported for calendar year 2016 depicted only initial encounters. All other calendar years included all ophthalmic emergency visits (initial and follow-up visits).*

References: [1]Pham JC, Ho GK, Hill PM, et al. National study of patient, visit and hospital characteristics associated with leaving an emergency department without being seen: predicting LWBS. Academic Emergency Medicine 2009; 16(10): 949–955. [2]Hsia RY, Asch SM, Weiss RE, et al. Hospital determinants of emergency department left without being seen rates. Ann Emerg Med 2011; 58(1): 24-32.e3. [3]Handel DA, Fu R, Daya M, et al. The use of scripting at triage and its impact on elopements. Acad Emerg Med 2010; 17(5): 495-500.

The Mass. Eye and Ear Emergency Department has a lower LWBS rate compared to national benchmarks.

Eye Trauma Surgery



The Eye Trauma Service at Mass. Eye and Ear provides efficient and successful surgical care for patients with open globe injuries from throughout the region.

Postoperative left eye with a complex corneal laceration and extensive iris involvement after initial repair.

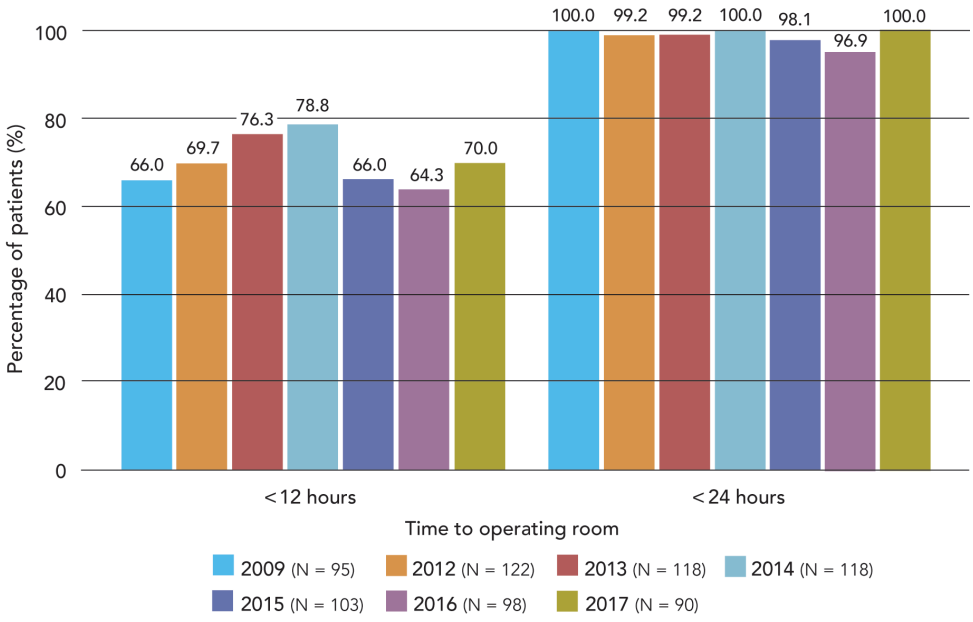
Photo courtesy of Alice Lorch, MD, MPH

Time to Surgical Repair for Open Globe Injuries

During calendar year 2017, 106 open globe injuries presented to the Eye Trauma Service. Of these, seven cases involving intraocular foreign bodies in the posterior segment were repaired by the Retina Service and nine dehisced penetrating keratoplasties were repaired by the Cornea Service; these were not included in the analysis. Ninety patients suffered open globe injuries that required urgent surgical repair by the Eye Trauma Service. All of the 90 patients with open globe injuries (100.0%) were taken to the operating room within 24 hours of arrival at Mass. Eye and Ear. Sixty-three of the 90 patients (70.0%) were taken to the operating room in under 12 hours. Open globe surgeries are sometimes appropriately delayed in the setting of multiple, possibly life-threatening, injuries that take priority for treatment.

The mean time from presentation at the Emergency Department to arrival in the operating room was 8.83 hours (range: 2.18 to 23.97 hours).

Multiple studies suggest the benefit of repairing open globe injuries within 12-24 hours after injury, in particular for the prevention of endophthalmitis.[1-2]



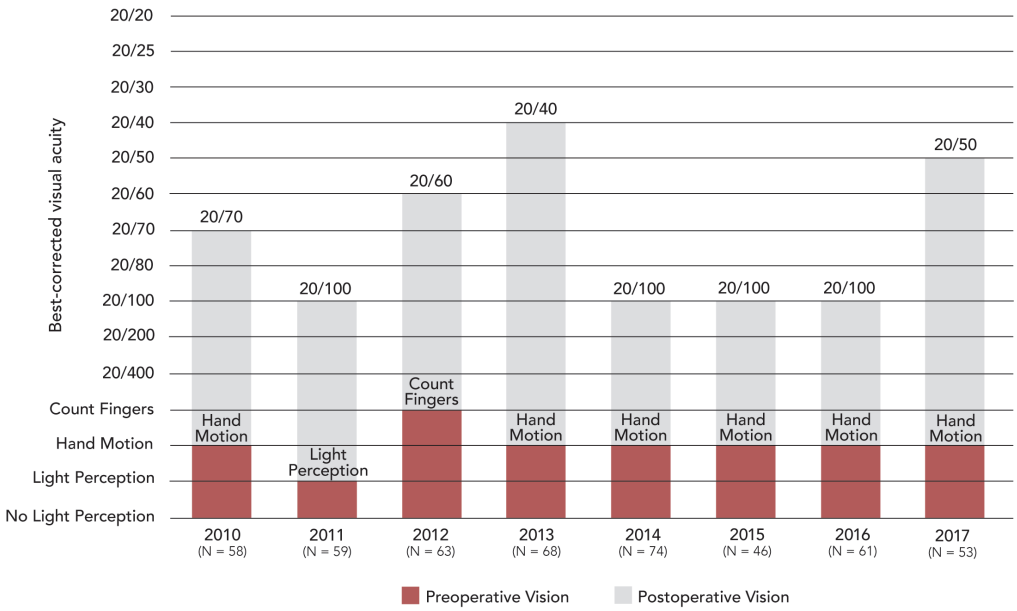
In calendar year 2017, the Eye Trauma Service repaired 100% of presenting open globe injuries within 24 hours after presentation to Mass. Eye and Ear. This rate is similar to prior years.

References: [1]Thompson, JT, Parver, LM, Enger, CL, et al. "Infectious endophthalmitis after penetrating injuries with retained intraocular foreign bodies." Ophthalmology 1993; 100(10): 1468-1474. [2]Cebulla, CM, Flynn Jr, HW. "Endophthalmitis after Open Globe Injuries." Am J Ophthalmol. 2009; 147(4): 567-568

Postoperative Median Vision

During the 2017 calendar year, 90 eyes of 90 patients had open globe repair by the Mass. Eye and Ear Eye Trauma Service. Of these 90 patients, visual acuity at presentation was recorded in 85 patients. Visual acuity was not possible in five patients due to their mental status. At the time of analysis, 53 patients had five months or more of follow-up at Mass. Eye and Ear, and only these individuals were analyzed for preoperative and postoperative vision. During the 2017 calendar year, the median preoperative vision was "hand motion," and the median postoperative vision at the closest follow-up visit after five months was 20/50.

Visual prognosis after ocular trauma is highly dependent on the severity of the initial trauma, but these data show that patients with a traumatic open globe injury can regain useful vision after surgery.



Reference: [1]Shah AS, Andreoli MT, Andreoli CM, et al. "Pediatric open-globe injuries: A large scale, retrospective review." Poster resented at the 37th Annual Meeting of the American Association for Pediatric Ophthalmology and Strabismus, San Diego, California, USA, March 30-April 3, 2011. Abstract available in J AAPOS 2011; 15(1), e29.

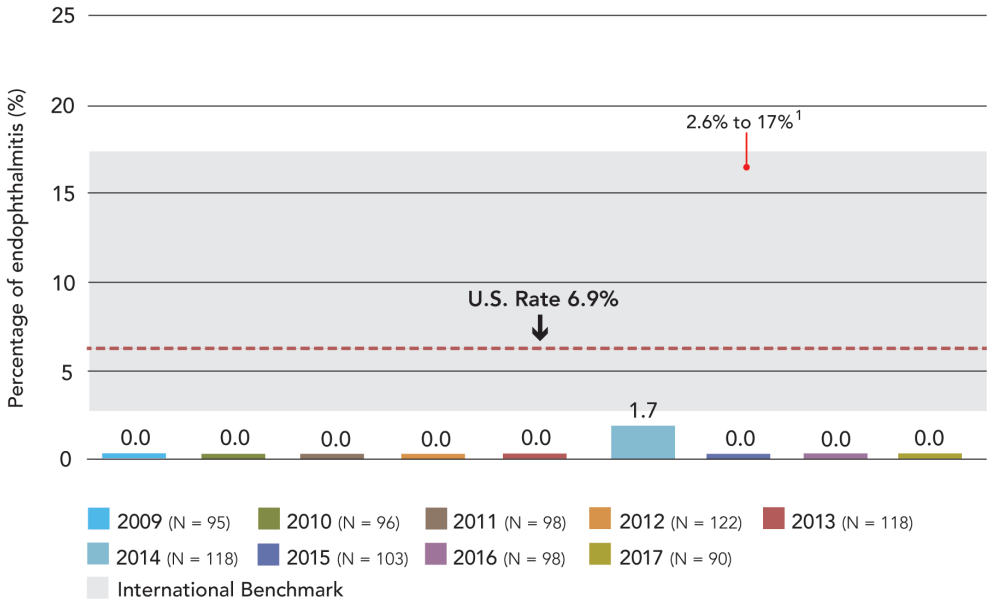
In a published retrospective review of 124 pediatric open globe injuries managed by the Eye Trauma Service and/or Retina Service between February 1999 and April 2009, analysis showed a median visual acuity at presentation of "hand motion" (N=123), and a final best corrected median visual acuity of 20/40 (N=124) at ten months median follow-up.[1]

Rates of Endophthalmitis After Open Globe Repair

During calendar year 2017, 90 patients underwent open globe repair by the Eye Trauma Service. Of these 90 patients, zero (0%) developed endophthalmitis. Similar results were reported since 2009 as shown in the graph.

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]

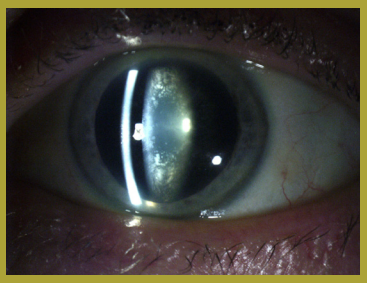
A published study of our antibiotic protocol for open globe injuries included 675 open globe injuries treated at Mass. Eye and Ear from January 2000 to July 2007. Intravenous vancomycin and ceftazidime were started on admission and stopped after 48 hours for all patients. Patients were discharged on 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).[1] 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.[1]



Reference: [1]Andreoli CM, Andreoli MT, Kloek CE, et al. Low rate of endophthalmitis in a large series of open globe injuries. Am J Ophthalmol 2009; 147(4): 601-608.

Cataract Surgery

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, surgical intervention, and subspecialty referrals for advanced care. The most common surgery performed at Mass. Eye and Ear is cataract extraction with intraocular lens implantation.



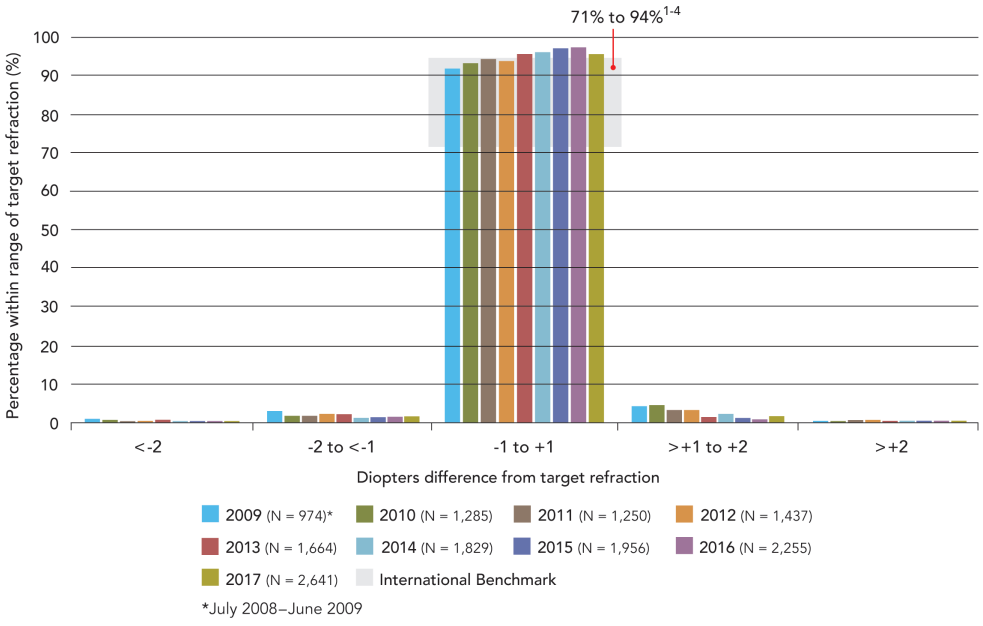
Preoperative photo of combined congenital and nuclear sclerotic cataract.

Photo courtesy of Alice Lorch, MD, MPH

Achieving Target Refraction (Spherical Equivalent)

During the 2017 calendar year, the Comprehensive Ophthalmology and Cataract Consultation Service performed cataract surgery on 2,892 eyes. This chart depicts the results of the 2,641 eyes that had at least one month of follow-up data. Of these 2,641 eyes, 95.8% (2,531/2,641) achieved within one diopter of target refraction after cataract surgery.

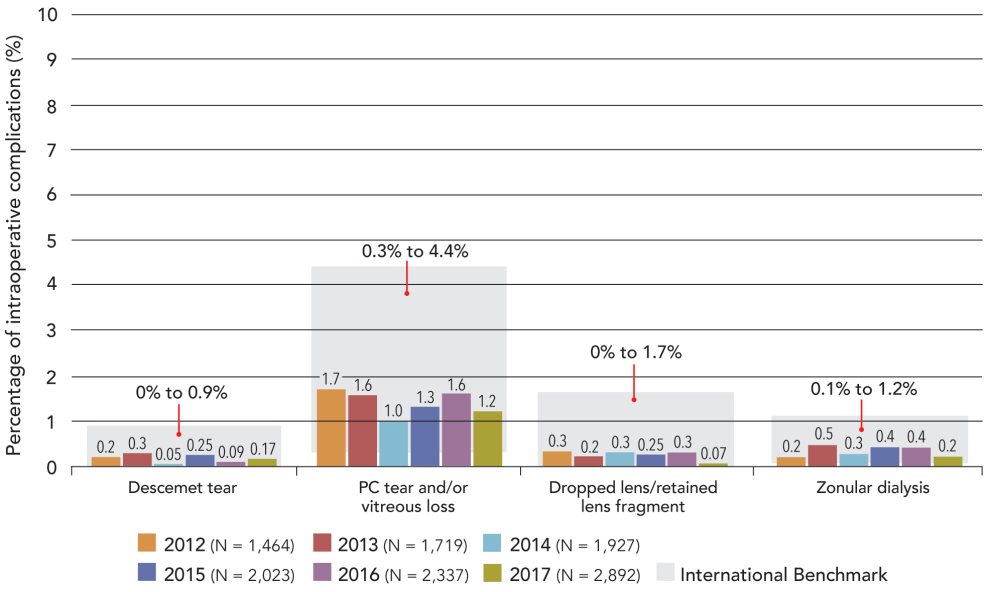
For the past nine years, the Comprehensive Ophthalmology and Cataract Consultation Service has consistently met or exceeded international benchmarks for successful cataract surgery.



References: [1]Kugelberg M, Lundström M. Factors related to the degree of success in achieving target refraction in cataract surgery: Swedish National Cataract Register study. J Cataract and Refract Surg 2008; 34(11): 1935-1939. [2]Cole Eye Institute. Outcomes 2012. [3]Lum F, Shein O, Schachat AP, et al. Initial two years of experience with the AAO National Eyecare Outcomes Network (NEON) cataract surgery database. Ophthalmology 2000; 107(4): 691-697. [4]Simon SS, Chee YE, Haddadin RI, et al. Achieving target refraction after cataract surgery. Ophthalmology 2014; 121(2): 440-444.

Intraoperative Complication Rates

Of the 2,892 cataract surgeries performed by the Comprehensive Ophthalmology and Cataract Consultation Service during the 2017 calendar year at all surgical locations, only 45 (1.6%) had intraoperative complications. These results are displayed in the graph below. Similar results were reported in calendar years 2012, 2013, 2014, 2015, and 2016, during which only 36/1,464 (2.5%), 44/1,719 (2.6%), 32/1,927 (1.7%), 37/2,023 (1.8%), and 44/2,337 (1.9%) of cataract surgeries, respectively, had intraoperative complications.



In calendar year 2017, there was one case of endophthalmitis after cataract surgery. The patient had best corrected vision 20/100 prior to surgery and presented 25 days after surgery with dense anterior and vitreous inflammation with best corrected vision 20/400. A tap and injection of intravitreal antibiotics (vancomycin and ceftazidime) were performed on the day of presentation. Culture was positive for Staphylococcus epidermidis and resistant to ampicillin and penicillin. At 5 months follow-up after treatment, the patient's visual acuity improved to 20/30.

Mass. Eye and Ear 2017 Intraoperative Complication Rates:

Descemet tear: 5/2,892 (0.17%)
Posterior capsule (PC) tear and/or vitreous loss: 36/2,892 (1.2%)
Dropped lens/retained lens fragment: 2/2,892 (0.07%)
Zonular dialysis: 6/2,892 (0.2%)

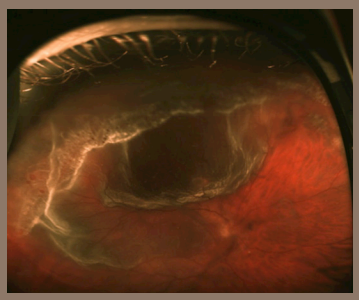
International Benchmarks:[1-5]

Descemet tear: 0% to 0.9%
Posterior capsule (PC) 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: [1]Greenberg PB, Tseng VL, Wu WC, et al. Prevalence and predictors of ocular complications associated with cataract surgery in United States veterans. Ophthalmology 2011; 118(3): 507-514. [2]Haripriya A, Chang DF, Reena M, et al. Complication rates of phacoemulsification and manual small-incision cataract surgery at Aravind Eye Hospital. J Cataract Refract Surg 2012; 38(8): 1360-1369. [3]Pingree MF, Crandall AS, Olson RJ. Cataract surgery complications in 1 year at an academic institution. J Cataract Refract Surg 1999; 25(5): 705-708. [4]Ng DT, Rowe NA, Francis IC, et al. Intraoperative complications of 1000 phacoemulsification procedures: a prospective study. J Cataract Refract Surg 1998; 24(10): 1390-1395. [5]McKellar MJ, Elder MJ. The early complications of cataract surgery: is routine review of patients 1 week after cataract extraction necessary? Ophthalmology 2001; 108(5): 930-935.

The Mass. Eye and Ear Comprehensive Ophthalmology and Cataract Consultation Service has some of the lowest intraoperative complication rates compared to international benchmarks.

Retina Surgery

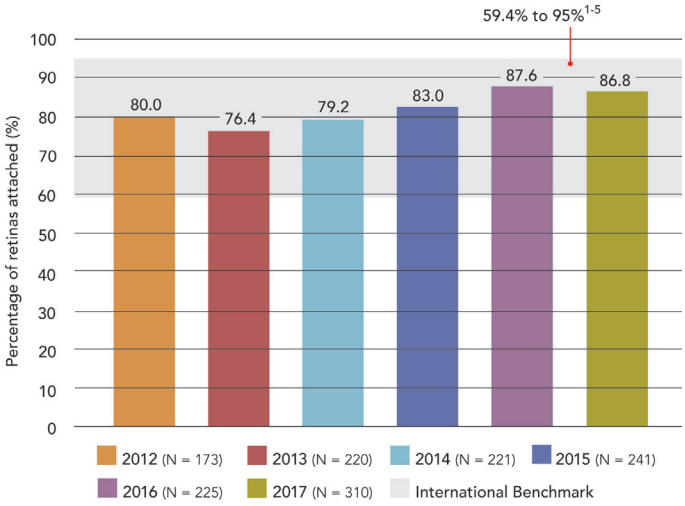


The Retina Service at Mass. Eye and Ear is one of the largest subspecialty groups of its kind in the country. Our clinicians are highly skilled at diagnosing and treating a full range of ocular conditions, including macular degeneration, diabetic retinopathy, retinal detachments, ocular tumors, intraocular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

Preoperative retinal detachment with extensive lattice and holes.

Photo courtesy of John B. Miller, MD

Single Surgery Success Rate for Primary Rhegmatogenous Retinal Detachment



Primary rhegmatogenous retinal detachment (RRD) is one of the most common retinal conditions requiring surgical repair by the Mass. Eye and Ear Retina Service. The Retina Service repairs RRDs with pneumatic retinopexy, pars plana vitrectomy, and/or scleral buckle surgery.

During calendar year 2017, the Mass. Eye and Ear Retina Service performed a total of 1,415 surgeries, of which 745 were for retinal detachments (RDs). From these 745 cases, we excluded chronic RDs of greater than one month duration as well as cases of RDs associated with proliferative vitreoretinopathy, macular holes, trauma, prior pars plana vitrectomy, children less than 18 years of age, Marfan's, or Stickler's syndrome. After exclusion criteria were applied, 310 uncomplicated primary RRD surgeries were analyzed. Single surgery success rate was 86.8% (or 269 of 310 eyes) at three months or greater of follow-up. Similar results were reported for calendar years 2012 to 2016.

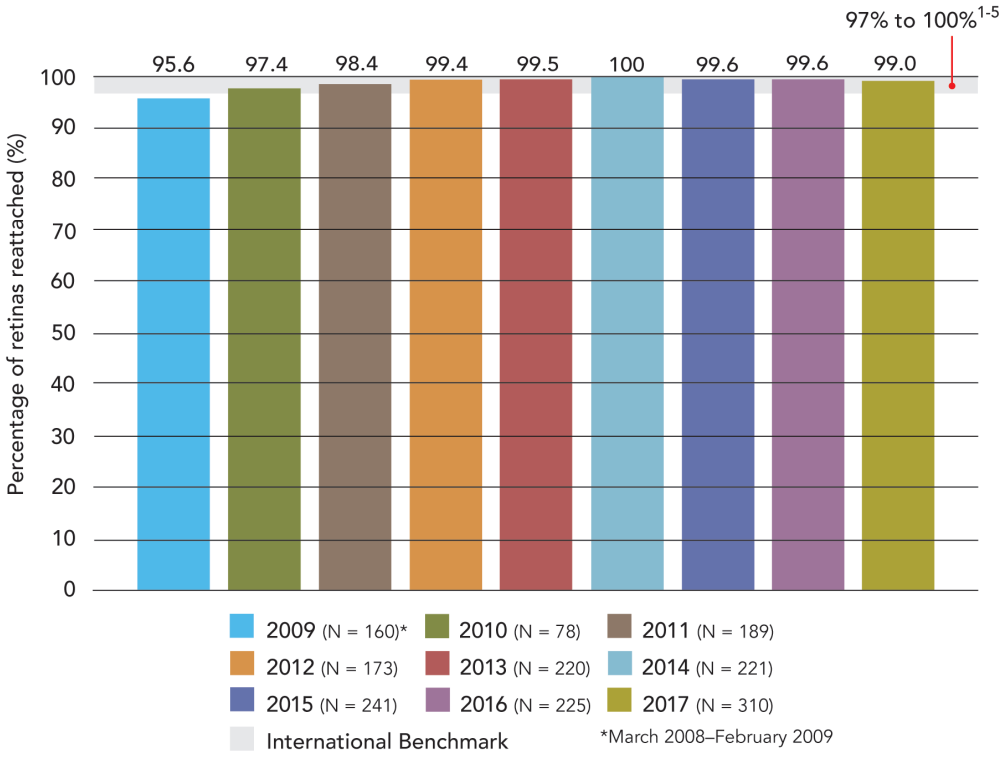
Benchmarks were determined from a literature review of studies that reported single surgery success rates for at least two of the three surgical techniques in this analysis (i.e., pneumatic retinopexy, pars plana vitrectomy, and/or scleral buckle).

References: [1]Soni C, Hainsworth DP, Almony A. Surgical management of rhegmatogenous retinal detachment: a meta-analysis of randomized controlled trials. Ophthalmology 2013; 120(7): 1440-1447. [2]Feltgen N, Heimann H, Hoerauf H, et al. Scleral buckling versus primary vitrectomy in rhegmatogenous retinal detachment study (SPR study): Risk assessment of anatomical outcome. SPR study report no.7. Acta Ophthalmol 2013: 91(3): 282-287. [3]Adelman RA, Parnes AJ, Ducournau D; European Vitreo-Retinal Society (EVRS) Retinal Detachment Study Group. Strategy for the management of uncomplicated retinal detachments: the European Vitreo-Retinal Society retinal detachment study report 1. Ophthalmology 2013; 120(9): 1804-1808. [4]Sodhi A, Leung LS, Do DV, et al. Recent trends in the management of rhegmatogenous retinal detachment. Surv Ophthalmol 2008; 53(1): 50-67. [5]Day S, Grossman DS, Mruthyunjaya P, et al. One-year outcomes after retinal detachment surgery among medicare beneficiaries. Am J Ophthalmol 2010; 150(3): 338-345.

Final Retinal Reattachment Rate for Primary Rhegmatogenous Retinal Detachment

During calendar year 2017, 310 uncomplicated primary RRD surgeries were analyzed to determine the final retinal reattachment rate.

Retinal reattachment was successfully achieved in 99.0% (307/310) of eyes. This success rate reflects eyes that had one or more surgeries, which may have included pars plana vitrectomy, scleral buckle, and pneumatic retinopexy. These 310 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 follow-up data.



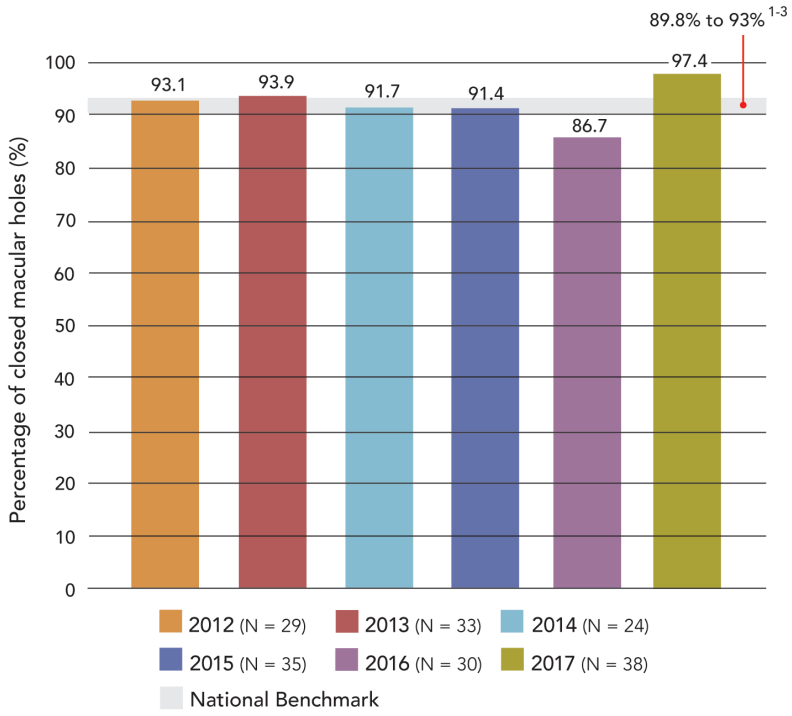
References: [1]Han DP, Mohsin NC, Guse CE, et al. Comparison of pneumatic retinopexy and scleral buckling in the management of primary rhegmatogenous retinal detachment. Southern Wisconsin Pneumatic Retinopexy Study Group. Am J Ophthalmol 1998; 126(5): 658-668. [2]Avitabile T, Bartolotta G, Torrisi B, et al. A randomized prospective study of rhegmatogenous retinal detachment cases treated with cryopexy versus frequency-doubled Nd:YAG laser-retinopexy during episcleral surgery. Retina 2004; 24(6), 878-882. [3]Azad RV, Chanana B, Sharma YR, et al. Primary vitrectomy versus conventional retinal detachment surgery in phakic rhegmatogenous retinal detachment. Acta Ophthalmol Scand 2007; 85(5): 540-545. [4]Sullivan PM, Luff AJ, Aylward GW. Results of primary retinal reattachment surgery: a prospective audit. Eye 1997; 11(Pt6): 869-871. [5]Day S, Grossman DS, Mruthyunjaya P, et al. One-year outcomes after retinal detachment surgery among medicare beneficiaries. Am J Ophthalmol 2010; 150(3): 338-345.

With a 99.0% success rate for primary RRD repair after one or more surgeries, the Mass. Eye and Ear Retina Service continues to maintain high success rates for this procedure. For the past eight years, the Retina Service has consistently met international benchmarks of 97% to 100% for successful RRD repair.[1-5]

Macular Hole Surgery: Single Surgery Success Rate at Three Months

During calendar year 2017, the Mass. Eye and Ear Retina Service performed 86 macular hole surgeries on 79 patients. Of these 86 macular hole surgeries, macular holes associated with RRD, macular holes associated with trauma, holes with a history of prior pars plana vitrectomy, and macular holes of greater than 6 months duration were excluded. After exclusion criteria were applied, a total of 38 primary macular hole surgeries on 38 eyes (which included pars plana vitrectomy, membrane peel, and gas tamponade) were included in the following analysis.

Of the 38 eyes, 37 (97.4%) 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. These results are a notable improvement from the rates reported for calendar years 2012 to 2016. A review of the literature suggests that single surgery success rates for macular hole surgery range from 89.8% to 93.0% nationally.[1-3] Of the 38 eyes included for analysis in calendar year 2017, 100.0% (38/38) achieved surgical success after one or two surgeries.



References: [1]Wu D, Ho LY, Lai M, et al. Surgical outcomes of idiopathic macular hole repair with limited post-operative positioning. Retina 2011; 31 (3): 609-611. [2]Smiddy WE, Feuer W, Cordahi G. Internal limiting membrane peeling in macular hole surgery. Ophthalmology 2001; 108(8): 1471-1478. [3]Guillaubey A, Malvitte L, Lafontaine PO, et al. Comparison of face-down and seated position after idiopathic macular hole surgery: a randomized clinical trial. Am J Ophthalmol 2008; 146(1): 128-134.

Rates of Endophthalmitis After Intravitreal Injection

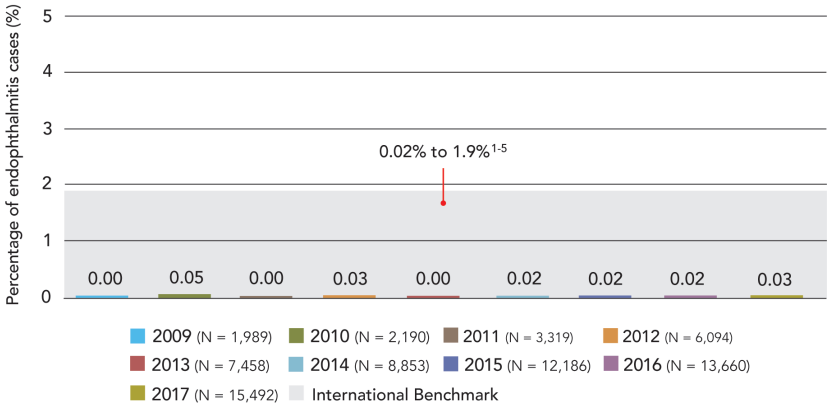
During the 2017 calendar year, the Mass. Eye and Ear Retina Service performed 15,492 intravitreal injections. Of these, four cases of infectious endophthalmitis (0.03%) were identified after intravitreal injections.

In the first case, the patient presented three days after intravitreal injection with a visual acuity of hand motion (pre-IVI vision was 20/30), hypopyon, anterior chamber inflammation, and vitreous inflammation. The patient underwent a vitreous and an anterior chamber tap with injection of intravitreal vancomycin and ceftazidime. Later that same day the patient underwent vitrectomy with repeat injection of vancomycin, ceftazidime, and dexamethasone. Vitreous culture showed bacillus species. Within a month, inflammation subsided and the infection resolved. At 9 months follow-up after treatment, the patient had best corrected vision of 20/500, compared to a baseline vision of 20/30.

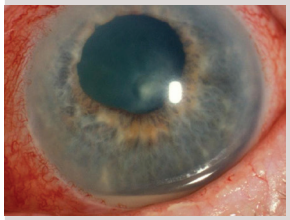
In the second case, the patient presented four days after intravitreal injection with anterior chamber cells, dense vitritis, hypopyon, and a visual acuity of hand motion (pre-IVI vision was 20/50). Anterior chamber and vitreous taps were performed with an intravitreal injection of antibiotics (ceftazidime and vancomycin) on the same day. Vitreous culture showed MRSA. A pars plana vitrectomy along with a second tap and injection of antibiotics (ceftazidime and vancomycin) was performed the next day. This patient's best corrected visual acuity (BCVA) was 20/40 at seven months post-treatment, which was better than the baseline vision. The patient underwent systemic MRSA treatment after confirmation of MRSA infection through nasal mucosal swab sampling.

The third case presented three days after intravitreal injection, with a visual acuity of hand motion (pre-IVI vision was 20/40), anterior chamber cells, and corneal haze. A vitreous tap was performed, and intravitreal antibiotics (ceftazidime and vancomycin) were given. The vitreous culture showed streptococcus growth. The next day, an anterior chamber washout, pars plana vitrectomy, and intravitreal injection of vancomycin, ceftazidime, and dexamethasone were performed. At 5 months post-treatment, the BCVA remained at 20/200 compared to a baseline vision of 20/40.

The fourth case presented four days after intravitreal injection with a visual acuity of hand motion, anterior chamber cells, fibrin, and dense vitritis. A vitreous tap and injection of vancomycin, ceftazidime, and dexamethasone along with an anterior chamber tap was performed on the same day. The vitreous culture showed Streptococcus parasanguinis. At 8 months post-treatment, the patient's BCVA was light perception compared to a baseline of 20/40.



References: [1]Bhavsar AR, Googe JM Jr, Stockdale CR, et al. Risk of endophthalmitis after intravitreal drug injection when topical antibiotics are not required: the diabetic retinopathy clinical research network laser-ranibizumab-triamcinolone clinical trials. Arch Ophthalmol 2009; 127(12): 1581-1583. [2]Englander M, Chen TC, Paschalis EI, et al. Intravitreal injections at the Massachusetts Eye and Ear Infirmary: analysis of treatment indications and postinjection endophthalmitis rates. Br J Ophthalmol 2013; 97(4): 460-465. [3]Fileta JB, Scott IU, Flynn HW Jr. Meta-analysis of infectious endophthalmitis after intravitreal injection of anti-vascular endothelial growth factor agents. Ophthalmic Surg Lasers Imaging Retina 2014; 45(2): 143-149. [4]VanderBeek BL, Bonaffini SG, Ma L. Association of compounded bevacizumab with postinjection endophthalmitis. JAMA Ophthalmol 2015; 133(10): 1159-1164. [5]Dossarps D, Bron AM, Koehrer P, et al. Endophthalmitis after intravitreal injections: incidence, presentation, management, and visual outcome. Am J Ophthalmol 2015; 160(1): 17-25.



(Top) Endophthalmitis of the right eye

Photo courtesy of Lucy H. Young, MD, PhD, FACS

Acute endophthalmitis is a rare potential complication of intravitreal injections. Mass. Eye and Ear's rates of endophthalmitis after intravitreal injection are low compared to international benchmarks.

The endophthalmitis rate for calendar year 2017 is similar to the overall rate for the past 9 calendar years (i.e. period from January 1, 2009 to December 31, 2017), where the overall rate of endophthalmitis after intravitreal injection was 0.02% (14 of 71,241 injections).

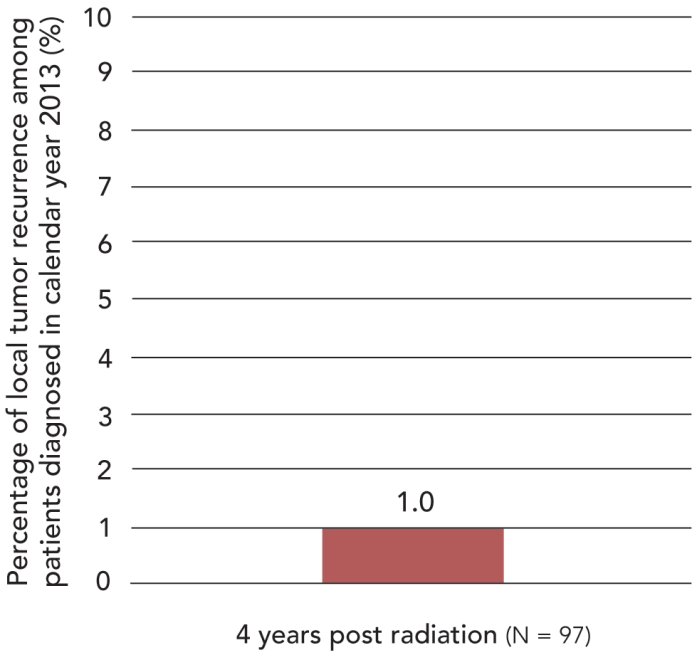
Management of Intraocular Tumors: Tumor Recurrence after Proton Therapy

The Ocular Melanoma Center at Mass. Eye and Ear is an international referral center for the diagnosis and treatment of eye neoplasms.

Uveal melanoma can be treated effectively with radiotherapy, achieving local control of the tumor in most cases and preserving visual function in many patients. Proton beam irradiation is one of the most effective types of radiotherapy for treating these tumors, with reported five-year cumulative failure rates ranging from 2% to 8.4%.[1,2]

One hundred and five patients were diagnosed with uveal melanoma in calendar year 2013. Of the 105 patients, four patients underwent enucleation and 101 patients received proton beam irradiation. Ninety-seven of these 101 patients returned for at least one follow-up visit and 32% (31/97) of these patients completed at least four years of follow-up by December 31, 2017. By the end of 2017, only one of the 97 patients (1.0%) experienced a recurrence. This recurrence was 34.2 months after initial treatment, and was retreated with proton beam irradiation.

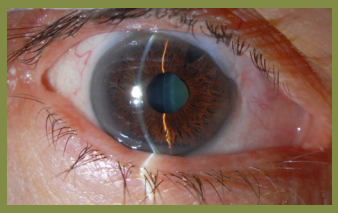
Proton beam irradiation was developed at Mass. Eye and Ear in conjunction with a team of radiotherapists from Massachusetts General Hospital. In 1975, the first proton beam irradiation treatment was administered to a Mass. Eye and Ear patient with intraocular malignant melanoma.



References: [1]Gragoudas ES, Lane AM, Munzenrider J, et al. Long-Term Risk of Local Failure after Proton Therapy for Choroidal/Ciliary Body Melanoma. Trans Am Ophthalmol Soc 2002;100:43-50. [2]Seibel I, Cordini D, Rehak M, et al. Local recurrence After Primary Proton Beam Therapy in Uveal Melanoma: Risk Factors, Retreatment Approaches, and Outcome. Am J Ophthalmol 2015;160:628-636.

Glaucoma Surgery

The Mass. Eye and Ear Glaucoma Consultation Service provides the full-spectrum of care — ranging from medical therapy and traditional surgery to the latest minimally invasive glaucoma surgeries (MIGS) — for patients of all ages. Our specialists treat patients with all forms and stages of glaucoma — including those with advanced disease — and are often referred complicated cases.



(Top) Postoperative glaucomatous right eye following trabeculectomy surgery. Note the formed bleb at 2 o'clock.

Photo courtesy of Teresa Chen, MD

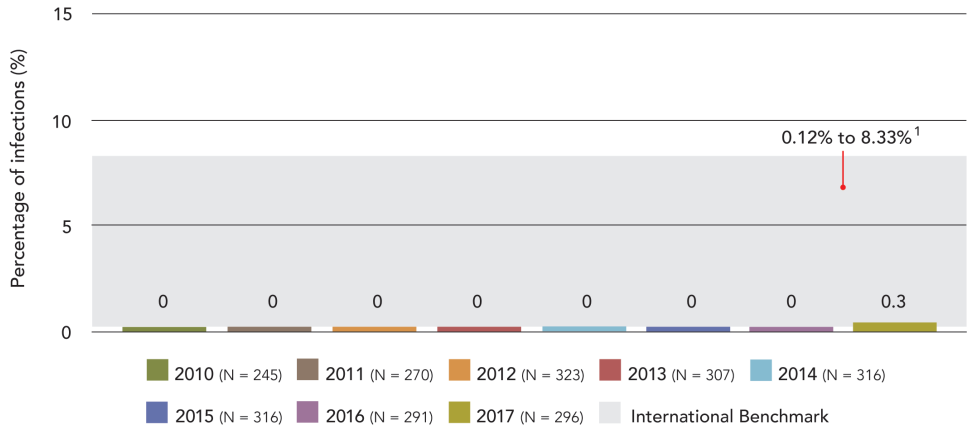
Trabeculectomy and Tube Shunt Infection Rates

The most common incisional surgeries performed at all surgical locations by the Mass. Eye and Ear Glaucoma Consultation Service are trabeculectomy and tube shunt surgery.

During the 2017 calendar year, the Glaucoma Consultation Service performed a total of 296 trabeculectomy and tube shunt surgeries on adults. These surgeries included trabeculectomy (with or without previous scarring) on 118 eyes, and tube shunt surgeries (primary or revision) on 178 eyes. Of these, 83 cases were combined with other procedures, such as cataract extraction or keratoprosthesis surgery. Of note, 21 pediatric cases performed by specialized faculty within the Glaucoma Service were excluded from this analysis.

A review of the literature suggests that trabeculectomy and tube shunt infection rates range from 0.12% to 8.33% internationally depending, in part, on the length of follow-up.[1]

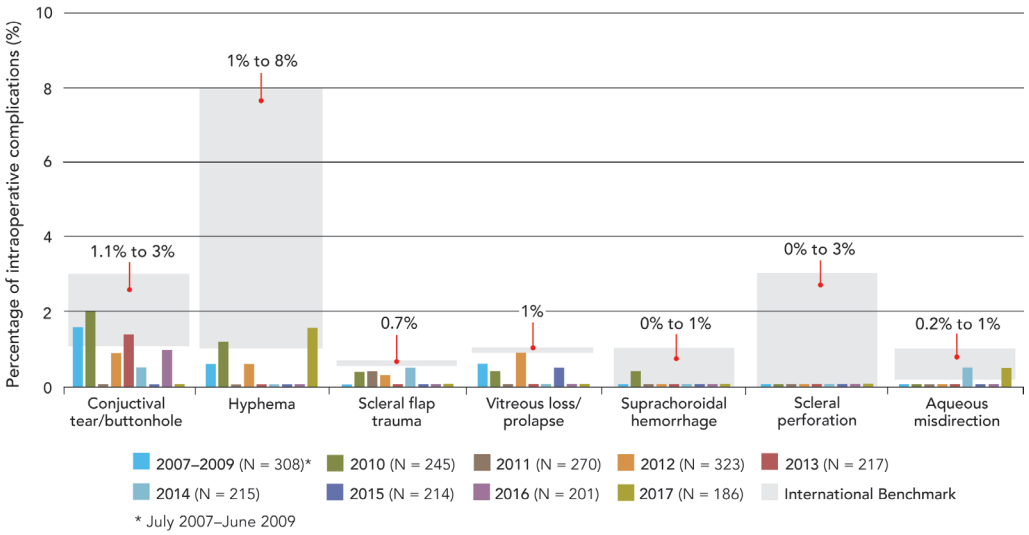
During calendar year 2017, there was one reported case of post-surgical endophthalmitis in the Glaucoma Service, leading to an infection rate of 0.3%. The patient presented with bleb-associated endophthalmitis 31 days after trabeculectomy and ExPRESS shunt insertion surgery with a hypopyon and a visual acuity of hand motion, compared to baseline of 20/25. An anterior chamber washout, pars plana vitrectomy, vitreous tap, and intravitreal injection of ceftazidime, vancomycin, and voriconazole were all performed on the same day of presentation. All cultures showed no growth. Bleb revision was performed for persistent hypotony after resolution of the infection. Eleven months after bleb revision surgery, the patient's vision was 20/80 in the setting of an epiretinal membrane.



Reference: [1]Ang GS, Varga Z, Shaarawy T. Postoperative infection in penetrating versus non-penetrating glaucoma surgery. Br J Ophthalmol 2010; 94(12): 1571-1576.

Trabeculectomy and Glaucoma Tube Shunt Surgery: Intraoperative Complications

During the 2017 calendar year, 296 trabeculectomy surgeries and glaucoma tube shunt surgeries were performed by the Glaucoma Consultation Service. 83 cases that were combined with other glaucoma procedures or with other concomitant procedures (i.e. cataract surgery, secondary lens implantation, or keratoprosthesis surgery), as well as 27 cases combined with Ex-PRESS implantations, were excluded, which left 186 cases for analysis. Of these, 97.8% (182/186) of patients had no intraoperative complications. For trabeculectomy and glaucoma tube shunt surgery, similar results were reported from calendar year 2010 to 2016, during which time 95.5% (234/245), 99.6% (269/270), 97.2% (314/323), 98.6% (214/217), 98.6% (212/215), 99.5% (213/214), and 99.0% (199/201) 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 2017 complication rates:

Conjunctival tear/buttonhole: **0%**
Hyphema: **1.6%**
Scleral flap trauma: **0%**
Vitreous loss (vitreous prolapse): **0%**
Suprachoroidal hemorrhage: **0%**
Scleral perforation: **0%**
Aqueous misdirection: **0.5%**

International benchmarks:[1-5]

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

The 186 cases evaluated included:

51 trabeculectomies without scarring
10 trabeculectomies with previous scarring
88 primary tube surgeries
37 tube revisions

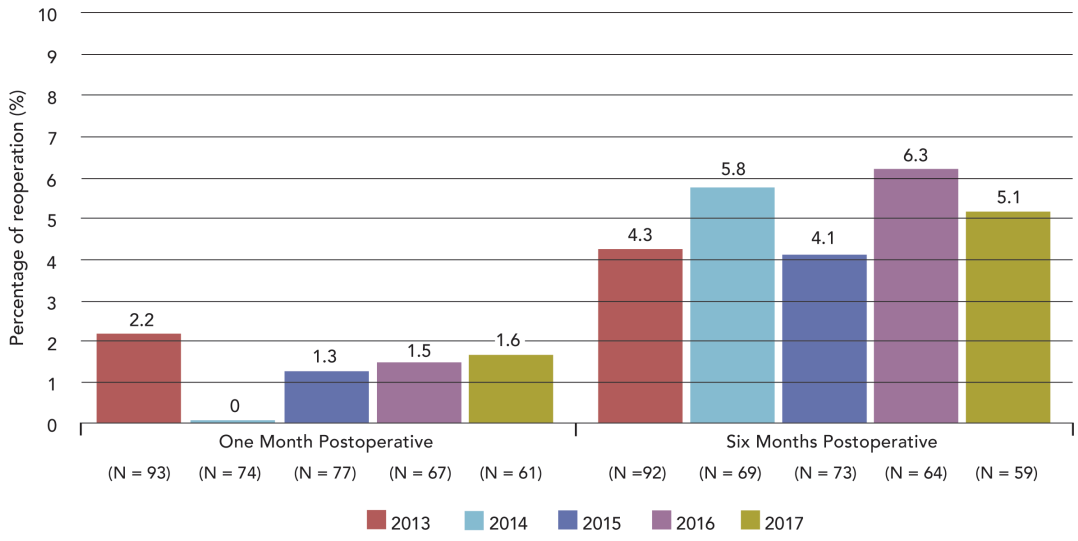
The Mass. Eye and Ear Glaucoma Consultation Service continues to maintain low intraoperative complication rates compared to international benchmarks.

References: [1]Barton K, Gedde SJ, Budenz DL, et al. Ahmed Baerveldt Comparison Study Group. The Ahmed Baerveldt Comparison Study methodology, baseline patient characteristics, and intraoperative complications. Ophthalmology 2011; 118(3): 435-442. [2]Jampel HD, Musch DC, Gillespie BW, et al. Perioperative complications of trabeculectomy in the Collaborative Initial Glaucoma Treatment Study (CIGTS). Am J Ophthalmol 2005; 140(1): 16-22. [3]Gedde SJ, Herndon LW, Brandt JD, et al. Surgical complications in the Tube Versus Trabeculectomy Study during the first year of follow-up. Am J Ophthalmol 2007; 143(1): 23-31. [4]Christakis PG, Tsai JC, Zurakowski D, et al. The Ahmed Versus Baerveldt study: design, baseline patient characteristics, and intraoperative complications. Ophthalmology 2011; 118(11): 2172-2179. [5]Kirwan JF, Lockwood AJ, Shah P, et al. Trabeculectomy in the 21st century: a multicenter analysis. Ophthalmology 2013; 120(12): 2532-2539.

Mitomycin C Trabeculectomy Reoperation Rates at One Month and Six Months

Trabeculectomy is the gold-standard incisional surgery for glaucoma patients who require surgical intervention. In this analysis, we excluded mitomycin C trabeculectomies that were combined with other procedures, such as cataract surgery, secondary lens implantation, keratoprosthesis procedures, and ExPRESS implantations. From a total of 118 trabeculectomy surgeries, this left 61 mitomycin C trabeculectomies (with or without previous scarring) performed by the Glaucoma Consultation Service for the 2017 calendar year at all surgical locations. Reoperation rates were calculated at the one-month and six-month postoperative time periods. Reoperations were defined as cases requiring further intraocular pressure lowering surgeries (i.e. repeat trabeculectomy, tube shunt surgery, diode cyclophotocoagulation). Two patients were lost to follow-up at the six-month time period.

The reoperation rate for mitomycin C trabeculectomy surgery was 1.6% at one month (1 repeat trabeculectomy in 61 patients available for follow-up) and 5.1% at six months (2 tube shunt surgeries and 1 diode cyclophotocoagulation in 59 patients who had sufficient follow-up). To the best of our knowledge, published data on one- and six-month reoperation rates are lacking; therefore, our reported rates will help to establish new benchmarks.

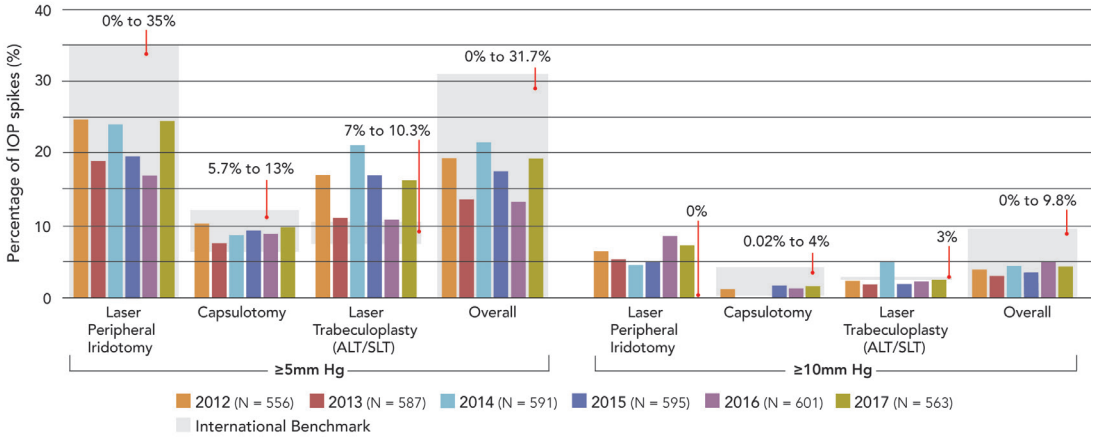


The Mass. Eye and Ear Glaucoma Consultation Service maintains low trabeculectomy reoperation rates within the first six months after surgery.

Glaucoma Laser Surgery: Intraocular Pressure (IOP) Spikes

During calendar year 2017, the Glaucoma Consultation Service performed anterior segment laser procedures, including peripheral iridotomies, capsulotomies, and laser trabeculoplasties, on 588 eyes. Of these, 563 eyes had complete information for analysis, numbering 250 laser peripheral iridotomies, 61 capsulotomies, and 252 laser trabeculoplasties. Of the 252 laser trabeculoplasties, 20 were argon laser trabeculoplasties (ALT) and 232 were selective laser trabeculoplasties (SLT). Medical charts were reviewed to determine the number of patients who developed an intraocular pressure spike of either ≥ 5 mmHg or ≥ 10 mmHg immediately after the laser procedure.

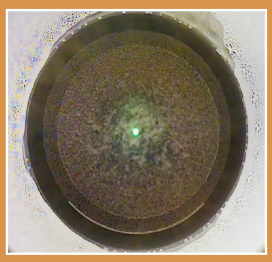
Preoperative and postoperative intraocular pressure (IOP) measurements were taken using the Tono-Pen (Reichert, Buffalo, NY) prior to the laser procedure and within one hour of the conclusion of the laser procedure. For this analysis, if multiple pressure readings were taken, the average pressure reading was used when calculating the IOP difference (postoperative minus preoperative). All measurements were taken by a certified ophthalmic technician. All patients received either brimonidine 0.1% or 0.15% or apraclonidine 0.5% before the laser procedure and prednisolone 1% after the procedure.



	≥5 mm Hg		≥10 mm Hg	
	Mass. Eye and Ear	International[1–8]	Mass. Eye and Ear	International[1, 3–4, 6–9]
Laser peripheral iridotomy:	24.4%	0% to 35%	7.2%	0%
Capsulotomy:	9.8%	5.7% to 13%	1.6%	0.02% to 4%
Laser trabeculoplasty:	16.3%	7% to 10.3%	2.4%	3%
Overall:	19.2%	0% to 31.7%	4.4%	0% to 9.8%

References: [1]Chevier RL, Assalian A, Duperré J, et al., Apraclonidine 0.5% versus brimonidine 0.2% for the control of intraocular pressure elevation following anterior segment laser procedures. Ophthalmic Surg Lasers 1999; 30(3): 199-204. [2]Yuen NS, Cheung P, Hui SP. Comparing brimonidine 0.2% to apraclonidine 1.0% in the prevention of intraocular pressure elevation and their pupillary effects following laser peripheral iridotomy. Jpn J Ophthalmol 2005; 49(2): 89-92. [3]Yeom HY, Lee JH, Hong YJ, et al. Brimonidine 0.2% versus brimonidine purite 0.15%: prophylactic effect on IOP elevation after Nd:YAG laser posterior capsulotomy. Journal of Ocular Pharm. & Therapeutics 2006; 22(3): 176-181. [4]Collum RD Jr, Schwartz LW. The effect of apraclonidine on the intraocular pressure of glaucoma patients following Nd:YAG laser posterior capsulotomy. Ophthalmic Surgery 1993; 24(9): 623-626. [5]Lai JS, Chua JK, Tham CC, et al. Five-year follow-up of selective laser trabeculoplasty in Chinese eyes. Clin Experiment Ophthalmol 2004; 32(4): 368-372. [6]Francis BA, Ianchulev T, Schofield JK, et al. Selective laser trabeculoplasty as a replacement for medical therapy in open-angle glaucoma. Am J Ophthalmol 2005; 140(3): 524–525. [7]Chen TC, Ang RT, Grosskreutz CL, et al. Brimonidine 0.2% versus apraclonidine 0.5% for prevention of intraocular pressure elevations after anterior segment laser surgery. Ophthalmology 2001; 108(6): 1033-1038. [8]Chen TC. Brimonidine 0.15% versus apraclonidine 0.5% for prevention of intraocular pressure elevation after anterior segment laser surgery. J Cataract Refractive Surg 2005; 31(9): 1707–1712. [9]Hong C, Song KY, Park WH, et al. Effect of apraclonidine hydrochloride on acute intraocular pressure rise after argon laser iridotomy. Korean J Ophthalmol 1991; 5(1): 37-41.

Refractive Surgery (Laser Vision Correction)



The Mass. Eye and Ear Cornea and Refractive Surgery Service provides the most advanced forms of refractive procedures, ranging from laser-assisted in situ keratomileusis (LASIK) and photorefractive keratectomy (PRK) to small incision lenticule extraction (SMILE) and implantable lenses.

(Top) Gas pattern after completion of the laser passes of SMILE.

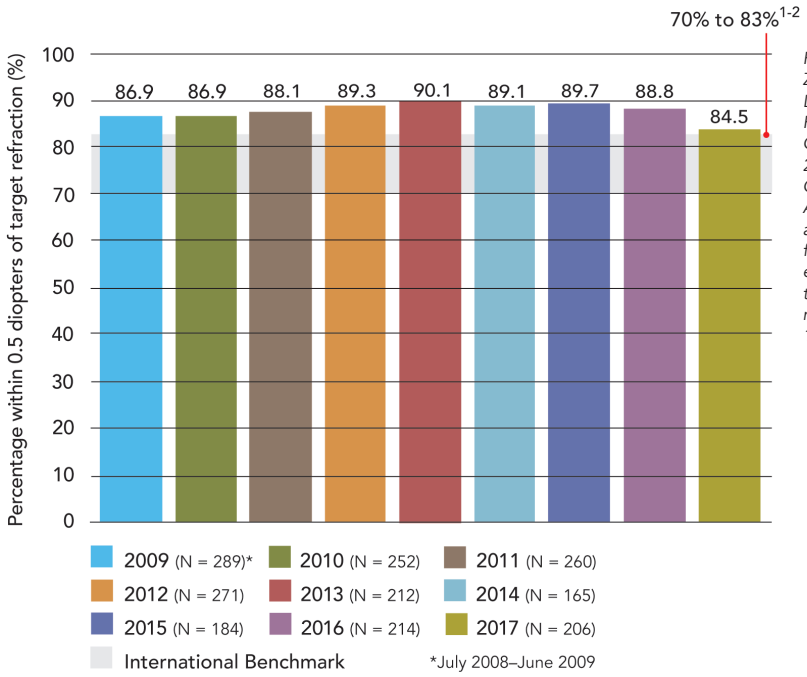
Photo courtesy of Kathryn M. Hatch, MD

LASIK for Myopia: Achieving Target Refraction (Spherical Equivalent)

During the 2017 calendar year, 272 eyes had LASIK surgery for myopia; of these, 206 had at least one month follow-up data for analysis and the LASIK success rate for myopia at one month was 84.5% (174/206 eyes).

Benchmark data from U.S. Food and Drug Administration (FDA) trials of LASIK for myopia showed that 71.6% of eyes resulted in a refractive error within 0.5 diopters of the intended target correction.[1] Further review of the literature suggests that after LASIK surgery for myopia, approximately 70% to 83% of eyes achieve within 0.5 diopters of the intended target correction.[1-2]

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



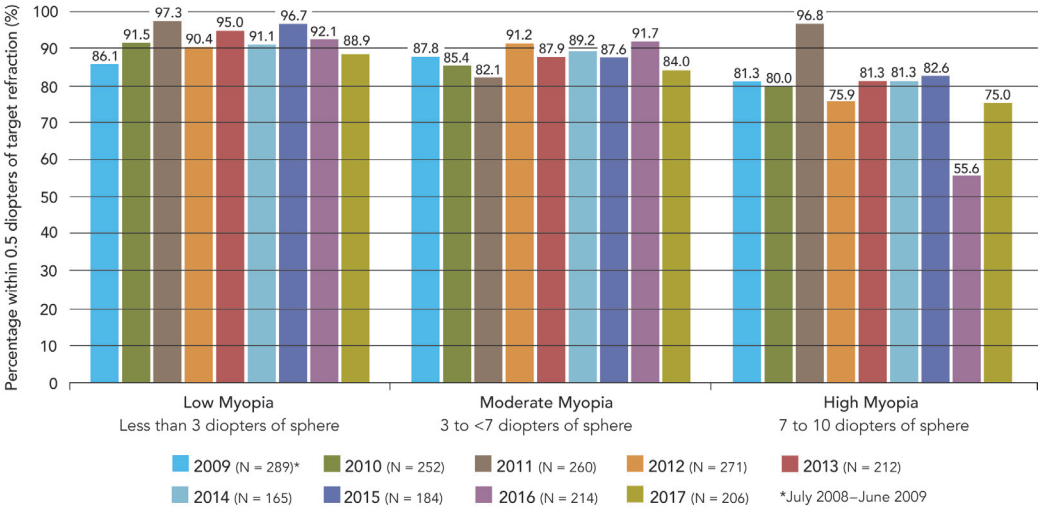
References: [1]Bailey MD, Zadnick K. Outcomes of LASIK for myopia with FDA-approved lasers. Cornea 2007; 26(3), 246–254. [2]Yuen LH, Chan WK, Koh J, et al. A 10-year prospective audit of LASIK outcomes for myopia in 37,932 eyes at a single institution in Asia. Ophthalmology 2010; 117(6): 1236–1244.

The overall LASIK success rate for achieving within 0.5 diopters of target refraction for myopia and hyperopia combined in 2017 was 84.4% (195/231 eyes).

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

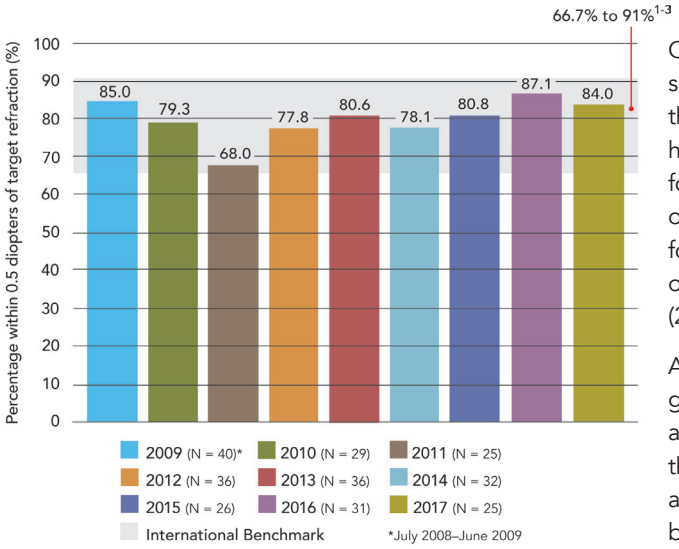
In calendar year 2017, 272 eyes had LASIK surgery for myopia; of these, 206 had at least one month follow-up data for analysis. The success rates based on the degree of myopia are illustrated here. LASIK for low myopia was performed on 72 eyes, and of these, 88.9% (64/72 eyes) were successful (achieved within 0.5 diopters of target refraction at one month follow-up). For the 106 eyes with moderate myopia, 84.0% (89/106 eyes) were successful; and for the 28 eyes with high myopia, 75.0% (21/28 eyes) achieved within 0.5 diopters of target refraction at one month follow-up.

Similar results were reported for low myopia and moderate myopia for calendar years 2010 to 2015. However, a reduction in success rate for high myopia was noted in the 2016 calendar year compared to previous years. Upon investigation it was difficult to assess the significance of this drop in the success rate given a low denominator of cases (18 cases).



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

LASIK for Hyperopia: Achieving Target Refraction (Spherical Equivalent)



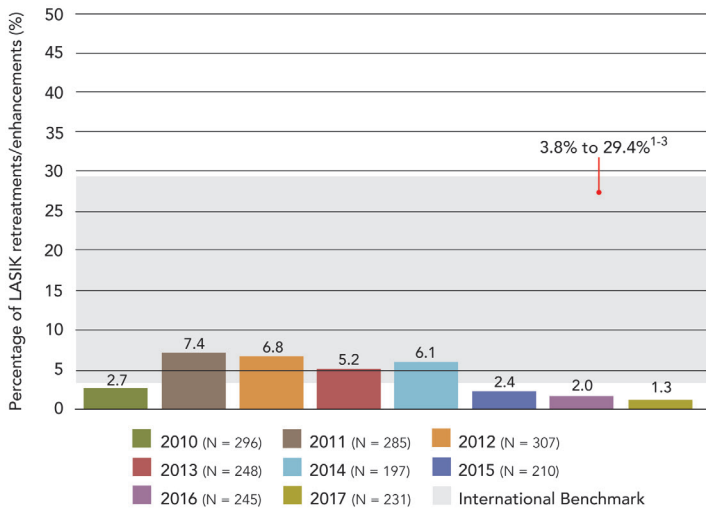
Of the 33 eyes that had LASIK surgery for hyperopia during the 2017 calendar year, 25 had three months or more of follow-up data for analysis. The overall 2017 LASIK success rate for achieving within 0.5 diopters of target refraction was 84.0% (21/25 eyes) for hyperopia.

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]

References: [1]Alió JL, El Aswad A, Vega-Estrada A, et al. Laser in situ keratomileusis for high hyperopia (>5.0 diopters) using optimized aspheric profiles: efficacy and safety. J Cataract Refract Surg 2013; 39(4): 519-527. [2]Keir NJ, Simpson T, Hutchings N, et al. Outcomes of wavefront-guided laser in situ keratomileusis for hyperopia. J Cataract Refract Surg 2011; 37(5): 886-893. [3]Cole Eye Institute. Outcomes 2012.

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

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



During the 2017 calendar year, 231 of the 305 eyes that had LASIK surgery had sufficient follow-up data for analysis. Sufficient follow-up was defined as at least one month of follow-up for myopia and three months follow-up for hyperopia. Of these 231 eyes, 1.3% (3/231) 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]

References: [1]Bragheeth MA, Fares U, Dua HS. Re-treatment after laser in situ keratomileusis for correction of myopia and myopic astigmatism. Br J Ophthalmol 2008; 92(11): 1506-1511. [2]Yuen LH, Chan WK, Koh J, et al. A 10-year prospective audit of LASIK outcomes for myopia in 37,932 eyes at a single institution in Asia. Ophthalmology 2010; 117(6): 1236-1244. [3]Alió JL, El Aswad A, Vega-Estrada A, et al. Laser in situ keratomileusis for high hyperopia (>5.0 diopters) using optimized aspheric profiles: efficacy and safety. J Cataract Refract Surg 2013; 39(4): 519-527.

For the past eight years, the Mass. Eye and Ear Cornea and Refractive Surgery Service has maintained low enhancement/retreatment rates compared to international benchmarks.

Cornea Surgery

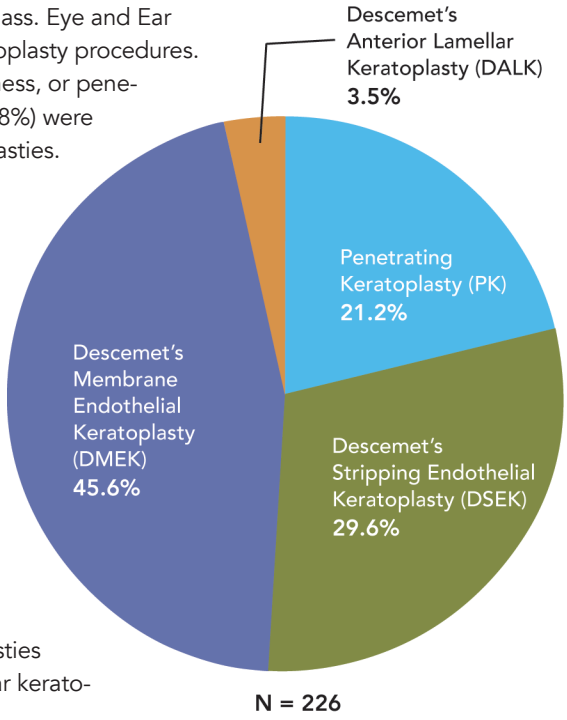
The Mass. Eye and Ear Cornea Service is highly skilled at correcting a variety of corneal disorders that disrupt vision. When appropriate, our clinicians perform more advanced lamellar procedures over penetrating keratoplasties in order to limit scarring and improve graft results.

Postoperative left eye following DMEK surgery with a faint S stamp denoting correct graft orientation.

Photo courtesy of Ula V. Jurkunas, MD

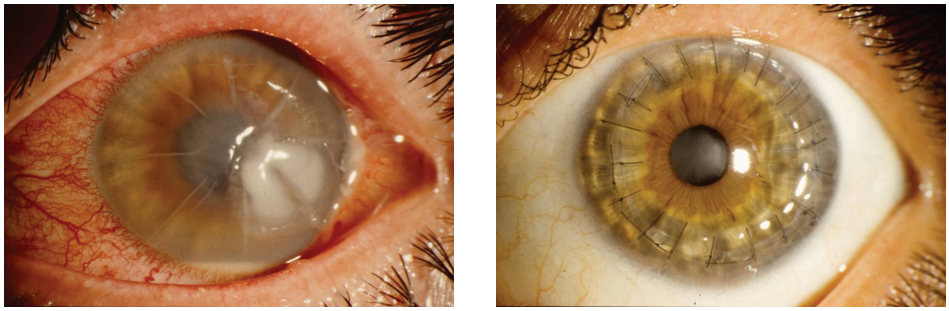
Distribution of Full-Thickness and Partial-Thickness Keratoplasty

During the 2017 calendar year, the Mass. Eye and Ear Cornea Service performed 279 keratoplasty procedures. Of these, 101 (36.2%) were full-thickness, or penetrating keratoplasty (PK) and 178 (63.8%) were partial-thickness, or lamellar keratoplasties. This distribution analysis excluded 33 PK procedures that were done in combination with retinal, glaucoma, or keratoprosthesis (KPro) procedures, as well as 20 therapeutic PK procedures done for active corneal infections or non-healing ulcers. This left 48 PKs for inclusion in the distribution analysis compared to 178 partial-thickness transplants. The subdivision of lamellar keratoplasty procedures was 67 Descemet's stripping endothelial keratoplasties (DSEKs), 103 Descemet's membrane endothelial keratoplasties (DMEKs), and 8 deep anterior lamellar keratoplasties (DALKs).



The Mass. Eye and Ear Cornea Service has faculty who specialize in pediatric keratoplasty cases. In calendar year 2017, the service performed 6 pediatric keratoplasty procedures, which have not been included in the analysis.

Penetrating Keratoplasty



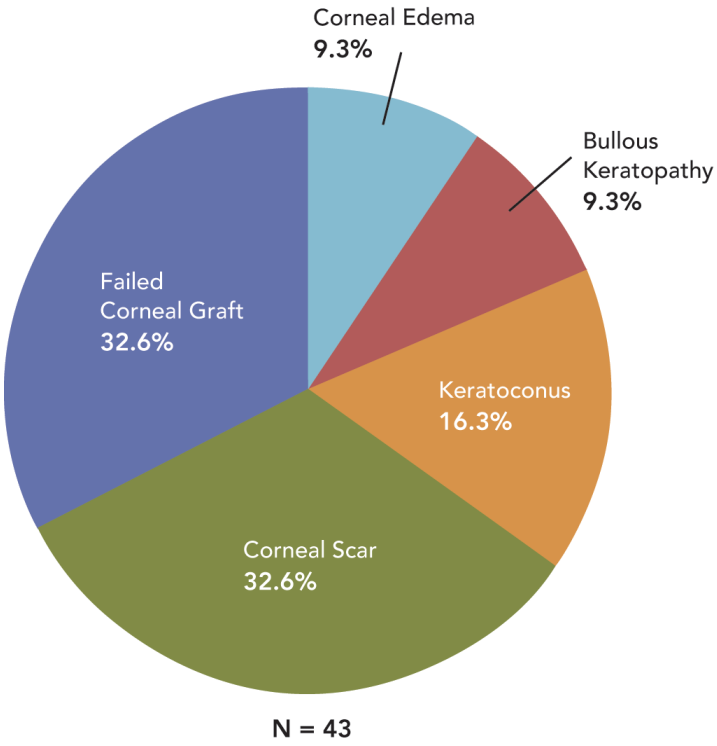
Preoperative and postoperative right eye that underwent penetrating keratoplasty (PK) for pseudomonas keratitis in a prior radial keratotomy incision.

Photos courtesy of James Chodosh, MD, MPH.

Surgical Indications for Penetrating Keratoplasty (PK)

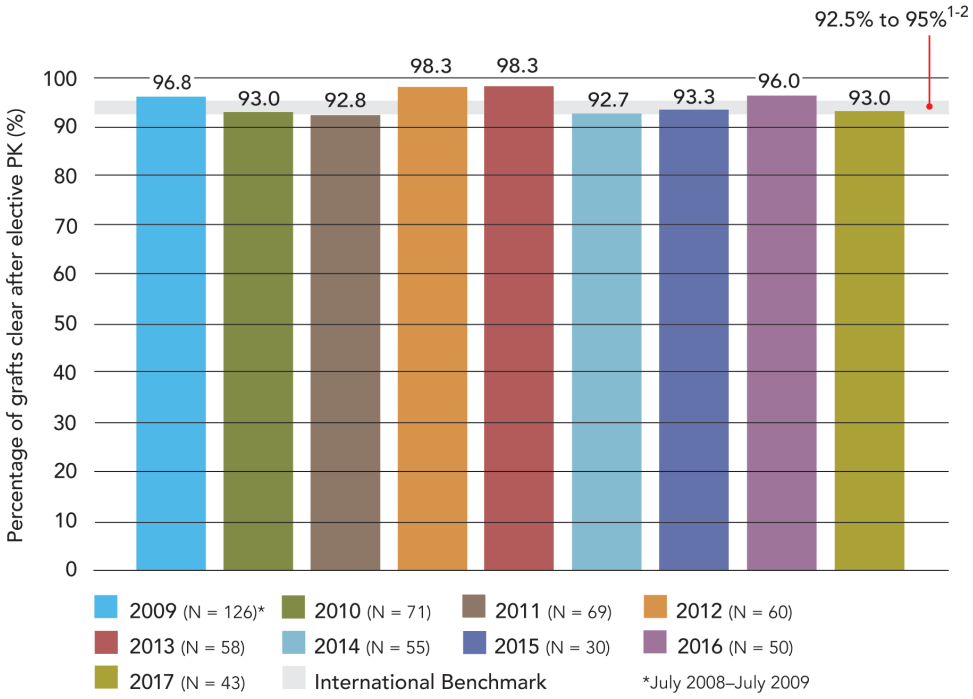
During the 2017 calendar year, 101 full-thickness penetrating keratoplasty (PK) procedures were performed by the Mass. Eye and Ear Cornea Service. The current analysis includes only elective PKs that had at least three months of follow-up data available and that were not done in combination with retinal, glaucoma, or keratoprosthesis (KPro) procedures. Using these exclusion criteria, 43 (42.6%) elective PKs remained for analysis for calendar year 2017. These 43 elective PKs included both 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 previous failed corneal graft.

Indications for elective PKs included failed corneal graft (14/43, 32.6%), corneal scar (14/43, 32.6%), keratoconus (7/43, 16.3%), bullous keratopathy (4/43, 9.3%), and corneal edema (4/43, 9.3%).



Cornea Surgery: Clear Corneal Grafts After Penetrating Keratoplasty (PK) Surgery at Three Months Follow-up

Of the 43 elective PKs included, 40 (93.0%) 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.

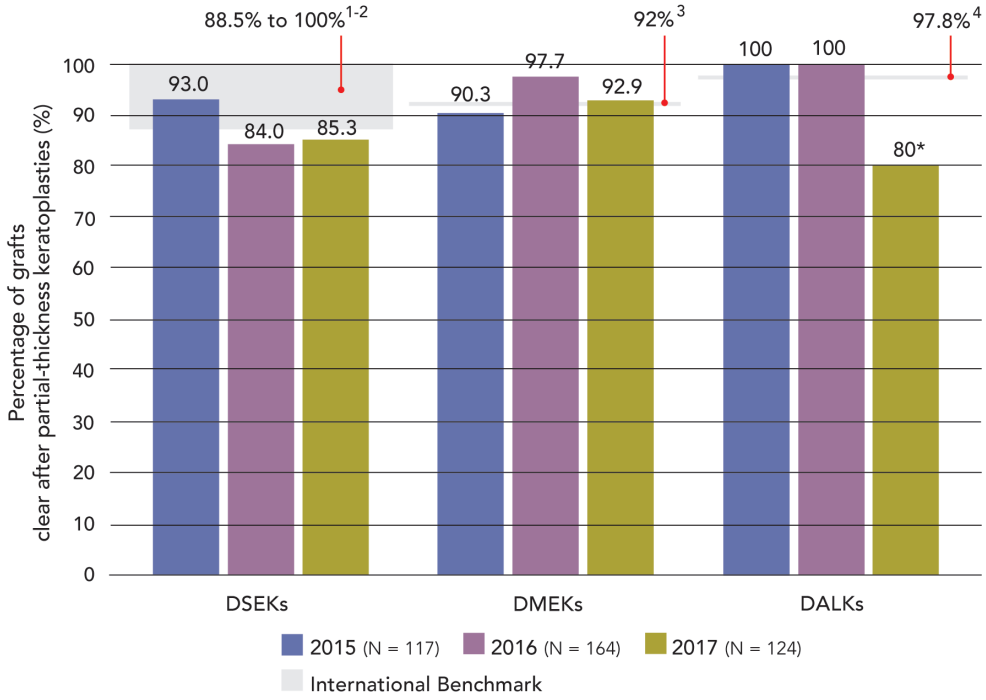


References: [1]Vail A, Gore SM, Bradley BA, et al. Corneal graft survival and visual outcome. A multicenter study. Corneal transplant follow-up study collaborators. Ophthalmology 1994; 101(1): 120-127. [2]Price MO, Thompson RW Jr, Price FW Jr. Risk factors for various causes of failure in initial corneal grafts. Arch Ophthalmol 2003; 121(8): 1087-1092.

Mass. Eye and Ear PK surgery success rates are comparable to international benchmarks.[1-2]

Clear Corneal Grafts After Partial-Thickness Keratoplasty Surgery at Three Months Follow-up

Of 178 partial-thickness keratoplasties performed in calendar year 2017 by the Mass Eye and Ear Cornea Service, 124 were elective procedures, not done in combination with retinal or glaucoma procedures, with at least three months of follow-up data, and as such, were included in the analysis. These 124 procedures included 34 Descemet's stripping endothelial keratoplasties (DSEKs), 85 Descemet's membrane endothelial keratoplasties (DMEKs), and 5 deep anterior lamellar keratoplasties (DALKs). Of these 124 procedures, 112 (90.3%) 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. When the data were subdivided by lamellar graft type, DMEK and DSEK graft success rates were similar compared to previous years. There was a decrease in DALK graft success rate in 2017 compared to prior years; however, the DALK success rate was not statistically significantly different to previous years given the limited number of grafts.



*With a significance level of 0.05, we did not find any statistically significant difference between the percentage of clear grafts after a DALK procedure in 2016 and 2017 (p value = 0.21).

References: [1]Basak SK. Descemet stripping and endothelial keratoplasty in endothelial dysfunctions:Three-month results in 75 eyes. Indian Journal of Ophthalmology 2008 56(4): 291-296. [2]Koenig SB, Covert DJ. Early results of small-Incision Descemet's stripping and automated endothelial keratoplasty. Ophthalmology 2007; 114(2): 221-226. [3]Price MO, Giebel AW, Fairchild KM, et al. Descemet's membrane endothelial keratoplasty: prospective multicenter study of visual and refractive outcomes and endothelial survival. Ophthalmology 2009; 116(12): 2361-2368. [4]Jones MN, Armitage WJ, Ayliffe W, et al. Penetrating and deep anterior lamellar keratoplasty for keratoconus: a comparison of graft outcomes in the United Kingdom. Invest Ophthalmol Vis Sci 2009; 50(12): 5625-5629.

Oculoplastic Surgery

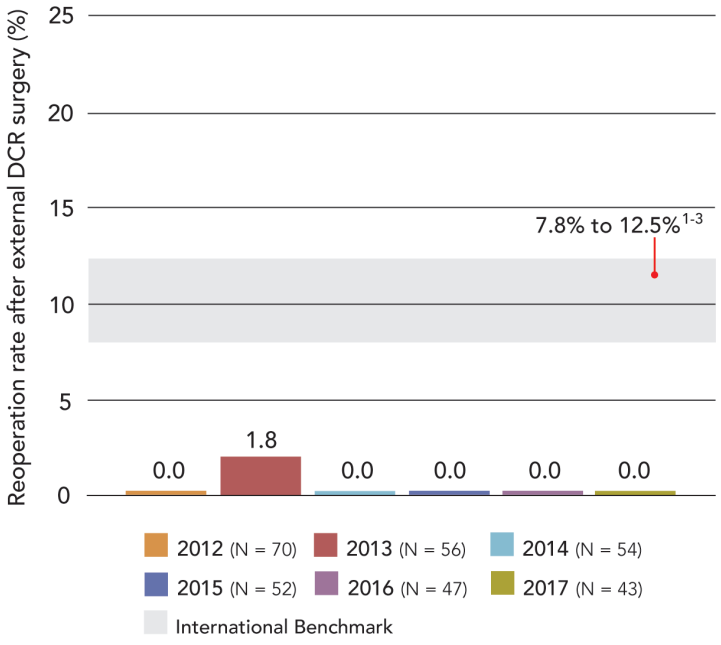
The Mass. Eye and Ear Ophthalmic Plastic Surgery Service performs a high volume of specialized treatments and surgeries to address facial and orbital disease and trauma.

Reoperation Rate for Primary External Dacryocystorhinostomy (Ex-DCR) Surgery at Six Months Follow-up

During the 2017 calendar year, the Mass. Eye and Ear Ophthalmic Plastic Surgery Service performed external dacryocystorhinostomy (Ex-DCR) procedures on 54 eyes of 41 patients. This year, three eyes of 3 patients were excluded for pre-existing ocular conditions (lymphoma, IgG4 disease of orbits, and post-traumatic lacrimal obstruction). Full exclusion criteria for pre-existing ocular conditions include granulomatosis with polyangiitis, sarcoidosis, cancer (e.g. lymphoma), benign tumors, post-traumatic lacrimal obstruction, and congenital cases. Eight eyes of 4 patients were excluded because of a history of prior lacrimal surgery. This analysis includes the remaining 43 eyes of 34 patients who underwent primary Ex-DCR in 2017 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 years 2012, 2014, 2015, and 2016, during which time there were no reoperations within six months of primary Ex-DCR.

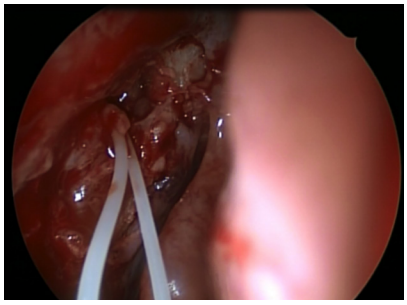
Ex-DCR is a common surgical method for NLDO. A review of the literature suggests that 7.8% to 12.5% of patients require reoperation following primary Ex-DCR for primary acquired NLDO.[1-3]

For the past six years, the Mass. Eye and Ear Ophthalmic Plastic Surgery Service has maintained a low reoperation rate for Ex-DCR surgeries compared to international benchmarks.



References: [1]Dolman PJ. Comparison of external dacryocystorhinostomy with nonlaser endonasal dacryocystorhinostomy. Ophthalmology 2003; 110(1): 78-84. [2]Karim R, Ghabrial R, Lynch TF, et al. A comparison of external and endoscopic endonasal dacryocystorhinostomy for acquired nasolacrimal duct obstruction. Clinical Ophthalmology 2011; 5: 979-989. [3]Ben Simon GJ, Joseph J, Lee S, et al. External versus endoscopic dacryocystorhinostomy for acquired nasolacrimal duct obstruction in a tertiary referral center. Ophthalmology 2005; 112(8): 1463-1468.

Reoperation Rate for Primary Endoscopic Dacryocystorhinostomy (En-DCR) Surgery at Six Months Follow-up

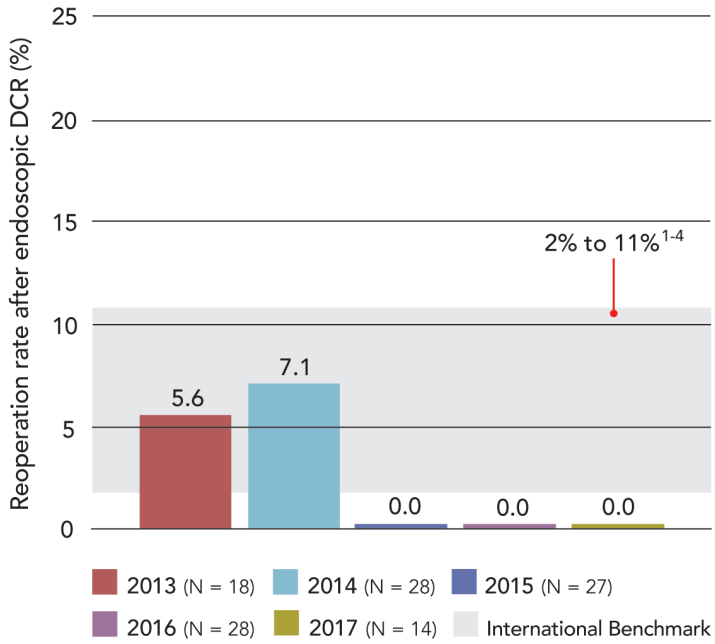


Intraoperative endoscopic view of endo-DCR ostium with silicone stent in position.

Photo courtesy of Daniel R. Lefebvre, MD, FACS

During the 2017 calendar year, the Mass. Eye and Ear Ophthalmic Plastic Surgery Service performed endoscopic dacryocystorhinostomy (En-DCR) procedures on 42 eyes of 34 patients. Thirteen eyes of 11 patients were excluded for pre-existing ocular conditions, such as granulomatosis with polyangiitis, sarcoidosis, cancer (e.g. lymphoma), benign tumors, post-traumatic lacrimal obstruction, and congenital cases. Fifteen eyes of 11 patients also were excluded because of a history of prior lacrimal surgery. This analysis includes the remaining 14 eyes of 14 patients who underwent primary En-DCR in 2017 for primary acquired nasolacrimal duct obstruction (NLDO). None of these 14 eyes 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.[1-4]



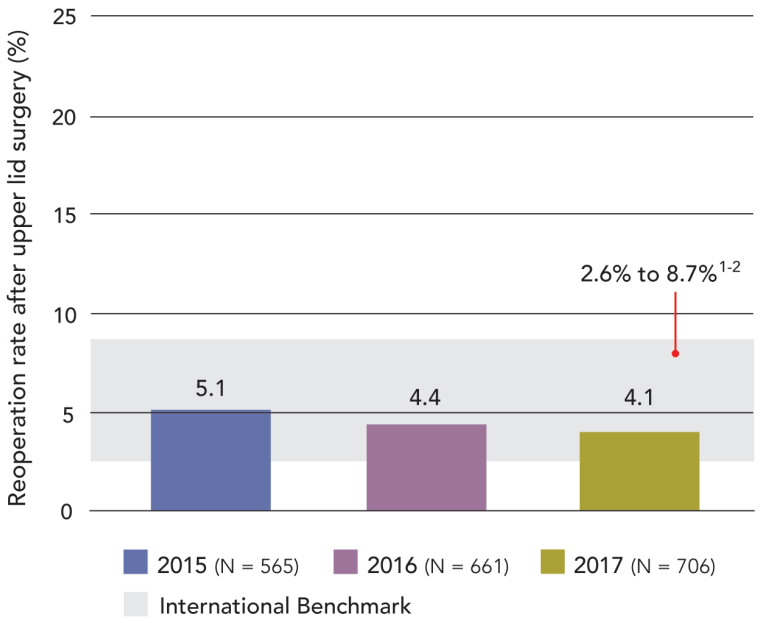
In contrast to conventional external DCR (Ex-DCR), En-DCR is a minimally invasive procedure that is possible due to technological advances in instruments used in rhinologic surgery. This analysis includes En-DCR procedures done in patients with underlying sinus disease or other intranasal abnormality such as significant septal deviation. Of the 42 eyes, 21 eyes of 17 patients who had concomitant chronic rhinosinusitis or severe septal deviation were done in collaboration with ENT surgeons from the Mass. Eye and Ear Rhinology Division.

References: [1]Dolman PJ. Comparison of external dacryocystorhinostomy with nonlaser endonasal dacryocystorhinostomy. Ophthalmology 2003; 110(1): 78-84. [2]Ben Simon GJ, Joseph J, Lee S, et al. External versus endoscopic dacryocystorhinostomy for acquired nasolacrimal duct obstruction in a tertiary referral center. Ophthalmology 2005; 112(8): 1463-1468. [3]Moore WMH, Bentley CR, Olver JM. Functional and anatomic results after two types of endoscopic endonasal dacryocystorhinostomy: surgical and holmium laser. Ophthalmology 2002; 109(8): 1575-1582. [4]Codère F, Denton P, Corona J. Endonasal dacryocystorhinostomy: a modified technique with preservation of the nasal and lacrimal mucosa. Ophthal Plast Reconstr Surg 2010; 26(3): 161-164.

Reoperation Rate for Upper Lid Surgeries at Six Months Follow-up

During the 2017 calendar year, the Mass. Eye and Ear Ophthalmic Plastic Surgery Service performed upper blepharoplasty and/or ptosis repair surgeries on 852 eyelids in 479 patients. These upper 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 852 lids, 146 were excluded because of a history of prior upper lid surgery, such as tumor removal, orbital decompression, blepharoplasty, and ptosis repair. This left 706 lids for the following analysis. Of these 706 lids, only 4.1% (29/706) required a second procedure within six months in order to achieve surgical success.

A review of the literature suggests that reoperation rates after eyelid surgery range from 2.6% to 8.7%.[1-2]



References: [1]Scoppettuolo E, Chadha V, Bunce C, et al. British Oculoplastic Surgery Society (BOPSS) National Ptosis Survey. Br J Ophthalmol 2008; 92(8): 1134–1138. [2]Melicher J, Nerad JA. Chapter 29: Ptosis surgery failure and reoperation. In: Cohen AJ, Weinberg DA, eds. Evaluation and management of blepharoptosis. New York: Springer; 2011, 269-274.

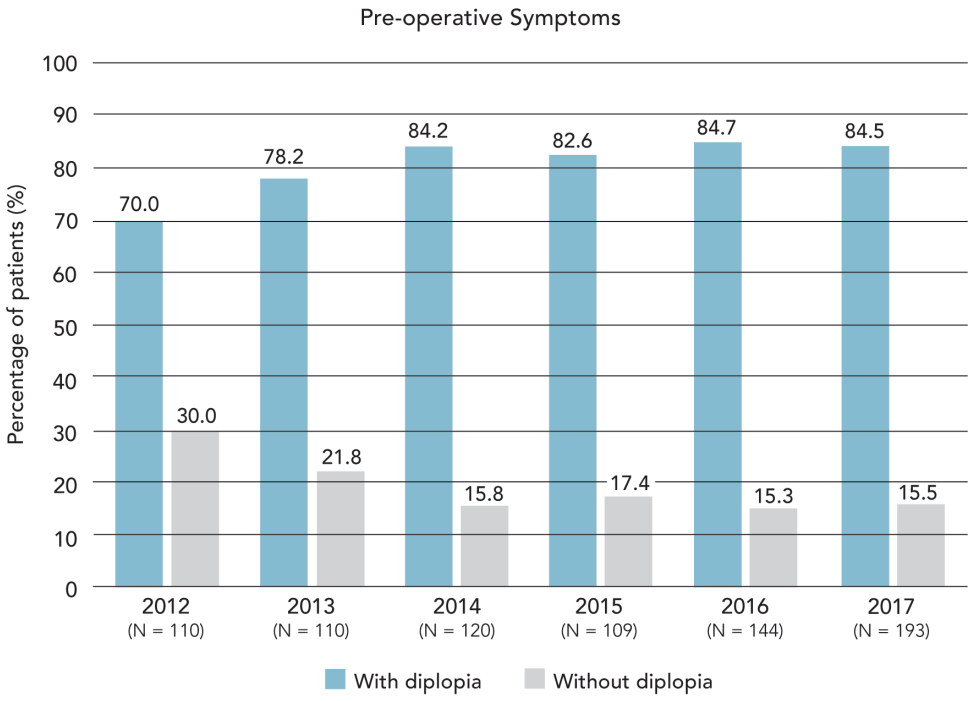
The Mass. Eye and Ear Ophthalmic Plastic Surgery Service has maintained a low reoperation rate for upper eyelid surgeries compared to international benchmarks.

Neuro-Ophthalmology Service

The Neuro-Ophthalmology Service at Mass. Eye and Ear provides comprehensive diagnoses and treatment for adults with strabismus. Treatment can include prism therapy, Botox injections, or strabismus surgery. The service is one of the few in the country that performs strabismus surgery specifically in adults.

Pre-operative Symptoms in Adult Strabismus Surgery Patients

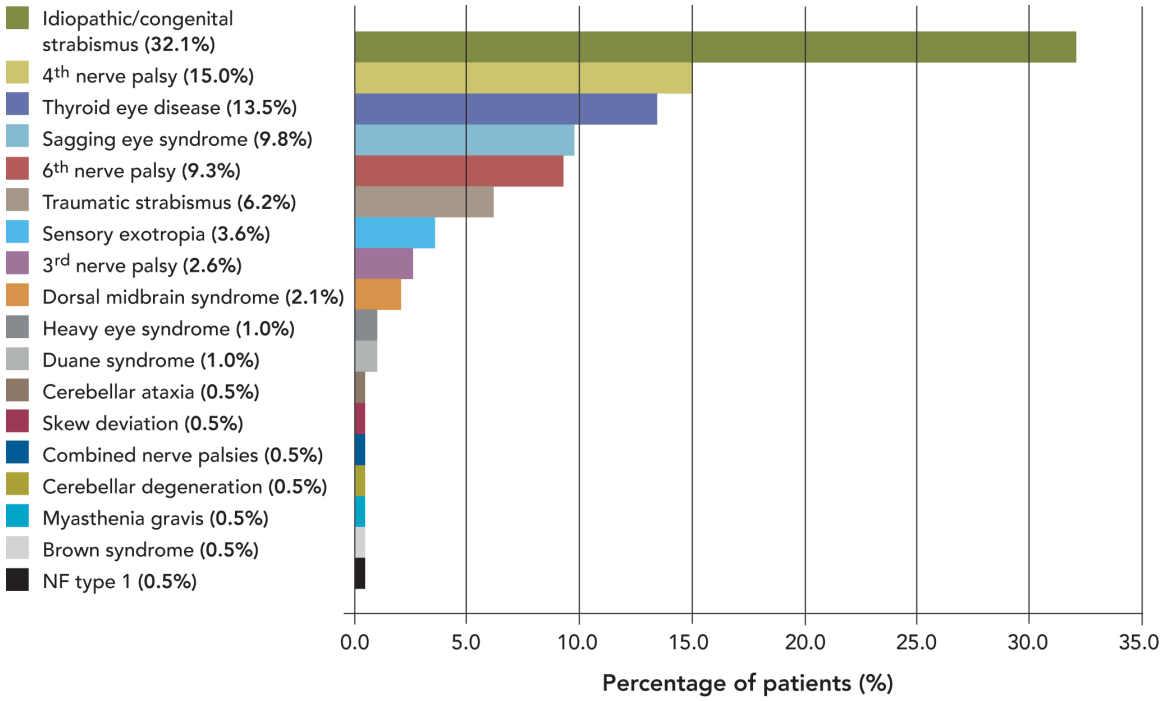
During the 2017 calendar year, the Mass. Eye and Ear Neuro-Ophthalmology Service performed strabismus surgery on 193 patients. The majority of patients (84.5% or 163 patients) had diplopia pre-operatively, while 15.5% or 30 patients did not have diplopia. Diplopia was also a common pre-operative symptom in prior calendar years, as shown below.



Diplopia is one of the most common indications for surgical intervention at the Mass. Eye and Ear Neuro-Ophthalmology Service.

Underlying Etiologies Associated with Adult Strabismus Surgery

The below analysis depicts the etiologies of adult strabismus surgery for calendar year 2017. Of the 193 strabismus surgery cases, the most common etiology was idiopathic or congenital strabismus (32.1% or 62 patients). Fourth nerve palsy was the second most common cause (15.0% or 29 patients). Other etiologies included thyroid eye disease (13.5% or 26 patients), sagging eye syndrome (9.8% or 19 patients), 6th nerve palsy (9.3% or 18 patients), traumatic strabismus (6.2% or 12 patients), sensory exotropia (3.6% or 7 patients), 3rd nerve palsy (2.6% or 5 patients), dorsal midbrain syndrome (2.1% or 4 patients), heavy eye syndrome (1.0% or 2 patients), and Duane syndrome (1.0% or 2 patients). There was one patient treated with each of the following diagnoses: cerebellar ataxia, skew deviation, combined nerve palsies, cerebellar degeneration, Myasthenia gravis, Brown syndrome, and neurofibromatosis (NF) type 1.



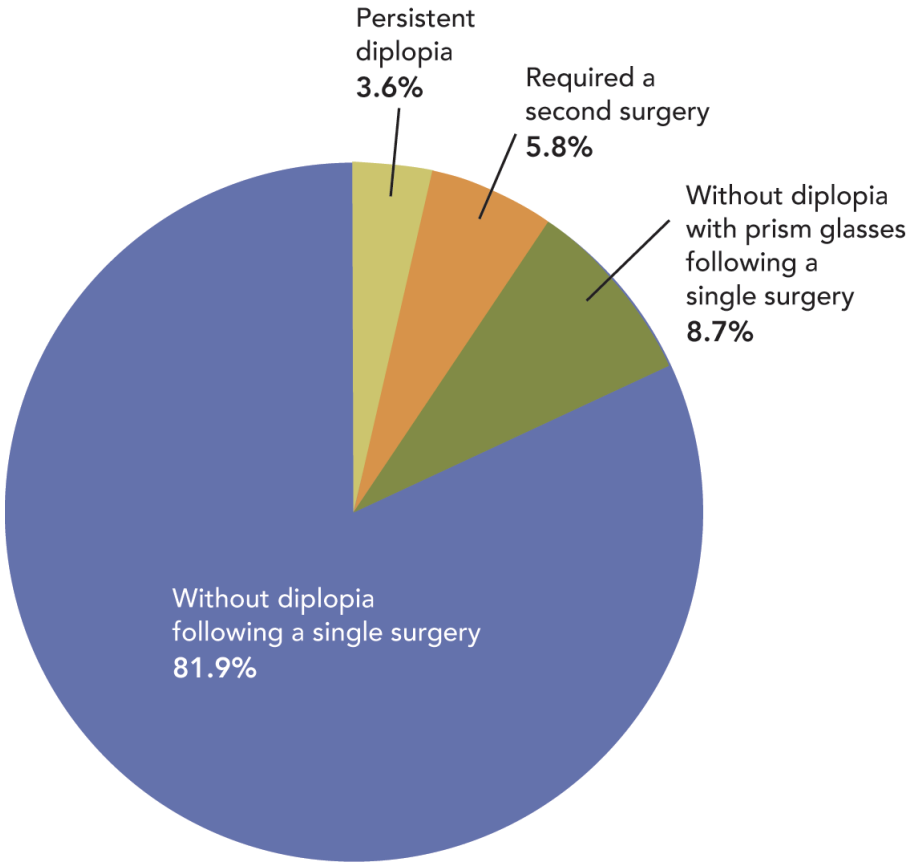
The most common indications for adult strabismus surgery in the Neuro-Ophthalmology Service were idiopathic/ congenital strabismus, 4th nerve palsy, thyroid eye disease, and sagging eye syndrome.

Success Rates for Adult Strabismus Surgery at Six Months Follow-up

In calendar year 2017, 163 of 193 patients (84.5%) had diplopia prior to their surgery. Of these 163 patients, 138 had at least one month follow-up data and therefore were included in the following analysis. Postoperatively, 113 of 138 patients (81.9%) were without diplopia in primary position or had a deviation less than six prism diopters after a single surgery that did not require prism glasses at their six month follow-up appointment. 12 of 138 patients (8.7%) who had diplopia after surgery were without diplopia in primary position with prism glasses. 12 of 138 patients (5.8%) required a second surgery that was either performed within 6 months (one patient) or scheduled by the time of their six month follow-up visit (7 patients). The remaining 5 of 138 patients (3.6%) had persistent diplopia at their follow-up appointment closest to 6 months.

Of the 193 patients that had strabismus surgery, 175 patients (90.7%) had the adjustable suture technique and 18 patients (9.3%) had a non-adjustable procedure. Of the 175 patients who underwent an adjustable procedure, 54 patients (30.9%) needed an adjustment in the immediate post-operative period 2 to 3 hours following surgery.

There were zero cases that were complicated by scleral perforation and zero cases developed an infection within 30 days of surgery. These results are the same as in calendar years 2012 to 2016.



After strabismus surgery at the Mass. Eye and Ear Neuro-Ophthalmology Service, most patients (81.9%) were without diplopia in primary position.

Neuro-Ophthalmology

The Neuro-Ophthalmology Service at Mass. Eye and Ear diagnoses and treats a wide variety of disorders that affect the cranial nerves and orbit, many of which require advanced imaging.

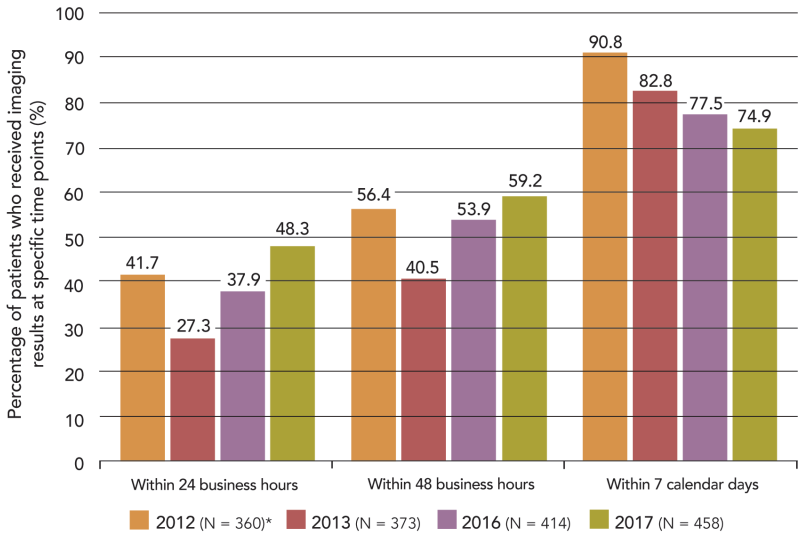
Providing Imaging Results to Patients

During calendar year 2017, the Mass. Eye and Ear Neuro-Ophthalmology Service ordered 458 outpatient neuroimaging scans (e.g. MRI, CT scans, etc.). Follow-up rates reflect the length of time from when the scan was performed to when the ordering physician was able to successfully reach the patient (not necessarily the first call to the patient).

Of the 458 imaging studies included in the 2017 analysis, scan follow-up rates were as follows: 221 scans (48.3%) were reviewed with the patient within one business day, 271 (59.2%) within two business days, 343 (74.9%) within seven calendar days, and 376 (82.1%) within 14 calendar days.

To the best of our knowledge, there are no ophthalmology studies that report the percentage of patients who receive imaging results at specified time points. The Veterans Health Administration (VHA) published guidelines in 2009 stating that all test results should be given to patients within 14 calendar days after the test results are made available to the physician. Similar guidelines have been published in the European community.[1-3]

Of the 458 scans that were ordered by a physician in the Neuro-Ophthalmology Service and also completed at Mass. Eye and Ear in 2017, 425 scans (92.8%) had documentation of when the patient was notified of the test results. Similar results were reported for calendar years 2012, 2013, and 2016 during which time 96.7% (348/360), 94.9% (354/373), and 98.1% (406/414) of scans had documentation of follow-up with the patient. A review of the literature revealed that physicians document their follow-up with patients for 64.3% to 100% of scans ordered.[4-5]



**Additional scans were identified for calendar year 2012 that were not reported in the previous publication. Inclusion of these cases changed the rate of follow-up within 24 hours from 150/348 (43.1%) to 150/360 (41.7%); follow-up within 48 hours from 203/348 (58.3%) to 203/360 (56.4%); and within seven days from 327/348 (94%) to 327/360 (90.8%).*

[1]Singh H, Vij MS. Eight recommendations for policies for communicating abnormal test results. The Joint Commission Journal on Quality and Patient Safety 2010; 36(5): 226-232. [2]Sittig D, Singh H. Improving test result follow-up through electronic health records requires more than just an alert. J Gen Intern Med 2012; 27(10): 1235-1237. [3]Rosenberg RD, Haneuse SJ, Geller BM, et al. Timeliness of follow-up after abnormal screening mammogram: variability of facilities. Radiology 2011; 261(2): 404-413. [4]Callen JL, Westbrook JI, Georgiou A, et al. Failure to follow-up test results for ambulatory patients: a systematic review. J Gen Intern Med 2012; 27(10): 1334-1348. [5]Casalino LP, Dunham D, Chin MH, et al. Frequency of failure to inform patients of clinically significant outpatient test results. Arch Intern Med. 2009; 169(12): 1123-1129.

The Mass. Eye and Ear Neuro-Ophthalmology Service has maintained favorable rates of follow-up for results of outpatient imaging studies compared to published guidelines and international benchmarks. It is difficult to determine whether the decreased rate of results reporting to patients within 7 calendar days over the past two years is truly representative of clinical care or due to difficulty with documentation in a new electronic medical record. As a result, efforts are in place to both emphasize to providers the importance of this communication as well as improve ease of accurate documentation within the system.

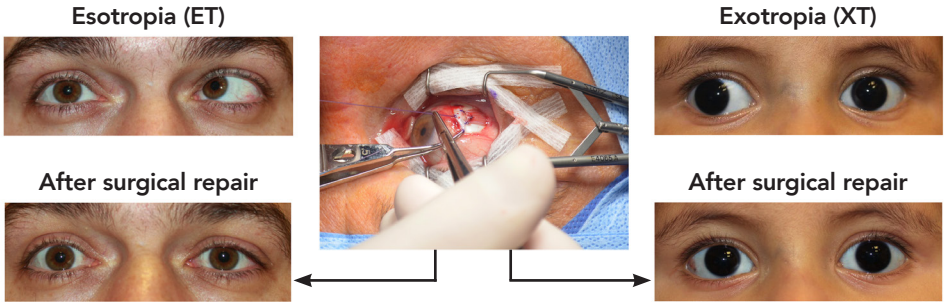
Pediatric and Adult Strabismus Surgery with Boston Children's Hospital: Goal-Determined Outcomes

Ophthalmologists with joint appointments at Boston Children's Hospital and the Massachusetts Eye and Ear Pediatric Ophthalmology and Strabismus Service offer subspecialized medical and surgical care for the full spectrum of pediatric ophthalmic disorders, including strabismus, cataract, anterior segment disease, oculoplastic surgery, neuro-ophthalmology, ocular trauma, ocular oncology, inherited retinal degenerations, and vitreoretinal surgery.

Strabismus surgery is the most commonly performed ophthalmic procedure in children, and is also performed on adults. Recession and resection procedures are most commonly performed for horizontal misalignment. Other surgeries less frequently performed include loop myopexies and transpositions.

Since the desired surgical outcome depends on the primary indication for surgery, the department designed a goal-determined methodology to assess surgical outcomes, which is utilized here.[1,2] This analysis includes all patients treated for horizontal strabismus without exclusion, and therefore facilitates stratification based on the presence or absence of risk factors (ophthalmic or systemic) that might impact results. The reported outcomes include procedures performed at Harvard Medical School ophthalmology affiliates by ophthalmologists with joint appointments at Boston Children's Hospital and the Massachusetts Eye and Ear Pediatric Ophthalmology and Strabismus Service. Procedures reported in the Neuro-Ophthalmology section are not included in this analysis.

Pediatric and Adult Strabismus Surgery



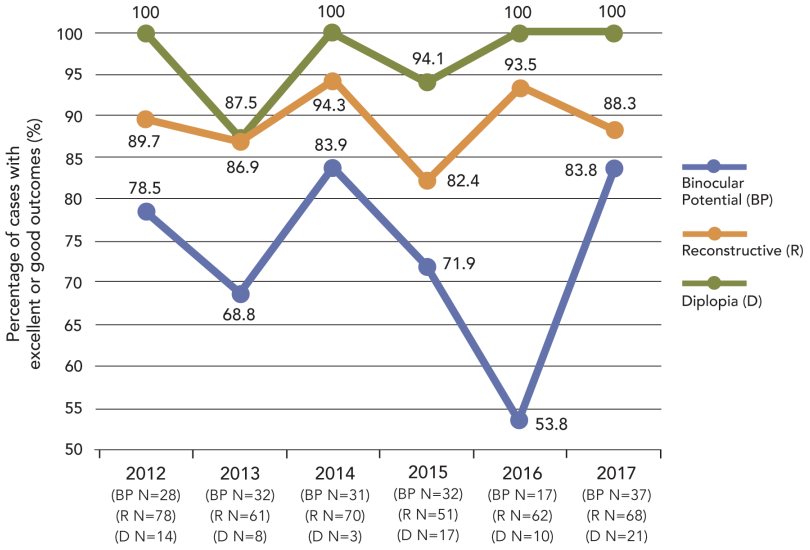
Preoperative and postoperative photos courtesy of Boston Children's Hospital, archive of ophthalmology department.

Intraoperative photo courtesy of Garyfallia Pagonis.

References: [1]Ehrenberg M, Nihalani BR, Melvin P, Cain CE, Hunter DG, Dagi LR. Goal-determined metrics to assess outcomes of esotropia surgery. J AAPOS 2014; 18(3): 211-216. [2]Chang YH, Melvin P, Dagi LR. Goal-determined metrics to assess outcomes of exotropia surgery. J AAPOS 2015; 19: 304-310.

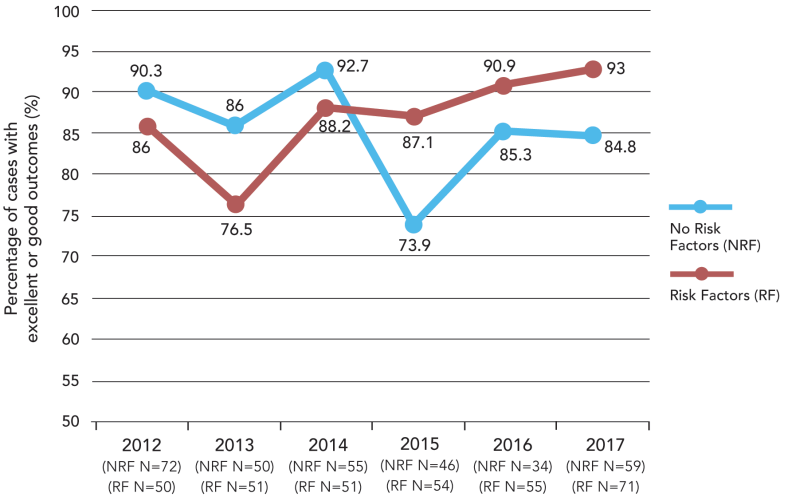
Exotropia Outcomes Stratified by Goal

In 2017, 130 patients with exotropia underwent strabismus surgery. Of these, 37 patients had surgery to restore binocular vision (binocular potential), 68 patients had reconstructive surgery for normalizing interpersonal interactions, and 21 patients had surgery to eliminate double vision (diplopia). The success rates (excellent or good outcomes) were 83.8%, 88.3%, and 100%, respectively. Four surgeries performed to resolve uncomplicated torticollis have been excluded from this analysis due to the small number.



Exotropia Outcomes Stratified by Risk Factors

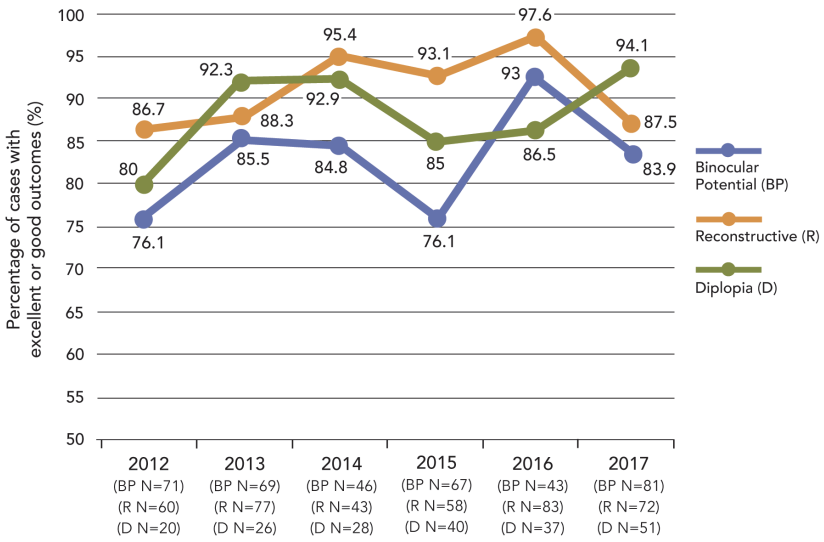
Of the 130 patients with exotropia, 71 patients had associated risk factors, and 59 patients had no associated risk factors. Risk factors include the following: bilateral vision limitation (e.g. albinism), conditions resulting in hyper-or hypotonia, craniosynostosis or craniofacial anomalies, 3rd nerve 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. Despite these complicating conditions, 93.0% of strabismus surgeries for exotropia with an above risk factor had an excellent or good outcome, as defined by the metrics published by Chang et al.[1]



[1]*Chang YH, Melvin P, Dagi LR. Goal-determined metrics to assess outcomes of exotropia surgery. J AAPOS 2015; 19: 304-310.*

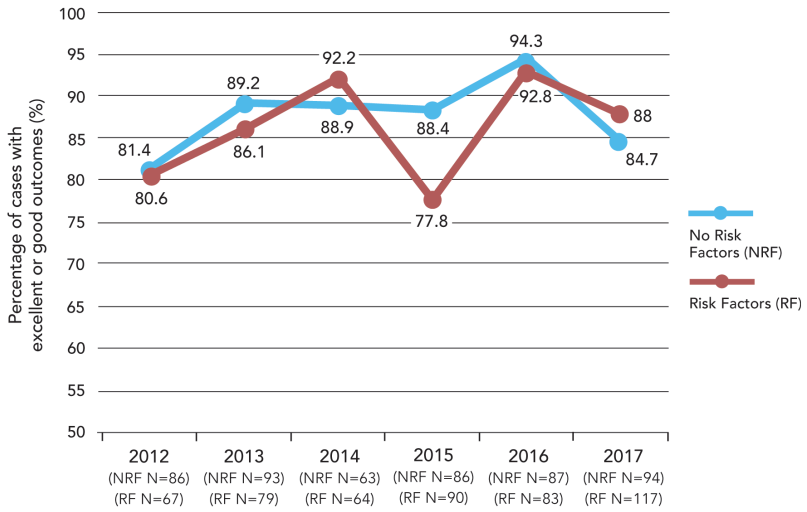
Esotropia Outcomes Stratified by Goal

In 2017, 211 patients with esotropia underwent strabismus surgery. Of these, 81 patients had surgery to restore binocular vision (binocular potential), 72 patients had reconstructive surgery for normalizing interpersonal interactions, and 51 patients had surgery to eliminate double vision (diplopia). The success rates (excellent or good outcomes) were 83.9%, 87.5%, and 94.1%, respectively. Seven surgeries performed to resolve uncomplicated torticollis have been excluded from this analysis due to the small number.



Esotropia Outcomes Stratified by Risk Factors

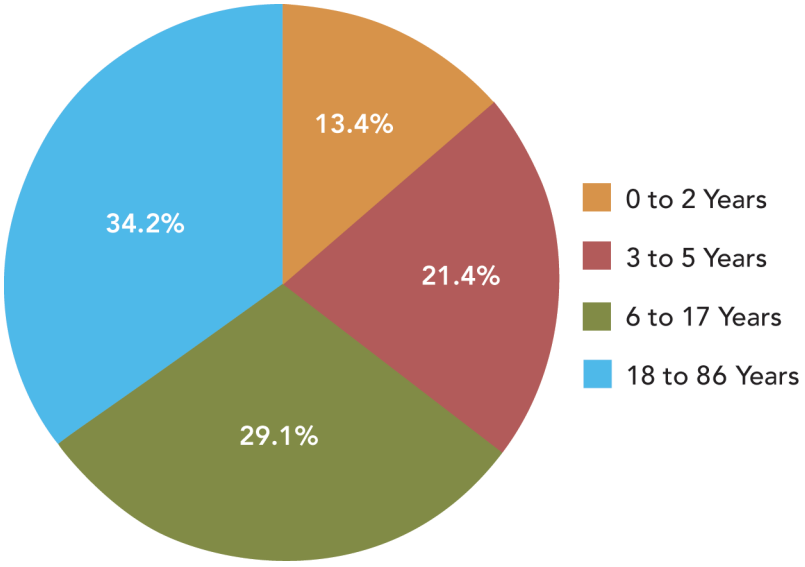
Of the 211 patients with esotropia, 117 patients had associated risk factors, and 94 patients had no associated risk factors. Despite these complicating conditions, 88.0% of strabismus surgeries for esotropia with an above risk factor had excellent or good outcomes as defined by the metrics published by Chang et al.[1]



[1]*Chang YH, Melvin P, Dagi LR. Goal-determined metrics to assess outcomes of exotropia surgery. J AAPOS 2015; 19: 304-310.*

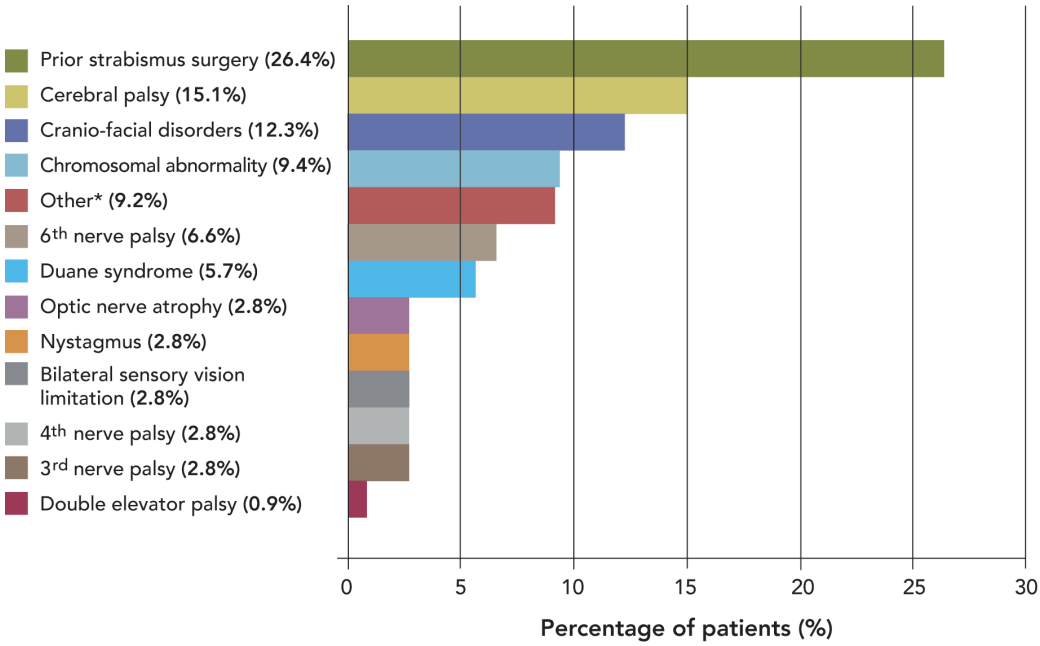
Distribution of Strabismus Patients by Age

The Strabismus Service at Boston Children's Hospital offers comprehensive evaluation and treatment for children and adults with strabismus. A total of 435 strabismus surgeries were performed in 2017, with patients ranging from 7 months to 86 years of age.



Distribution of Risk Factors in Strabismus Patients

Of the 435 strabismus surgeries performed in 2017, a total of 188 patients presented with associated risk factors. The most common risk factors were prior strabismus surgery (26.4%), cerebral palsy (15.1%), and cranio-facial disorders (12.3%).

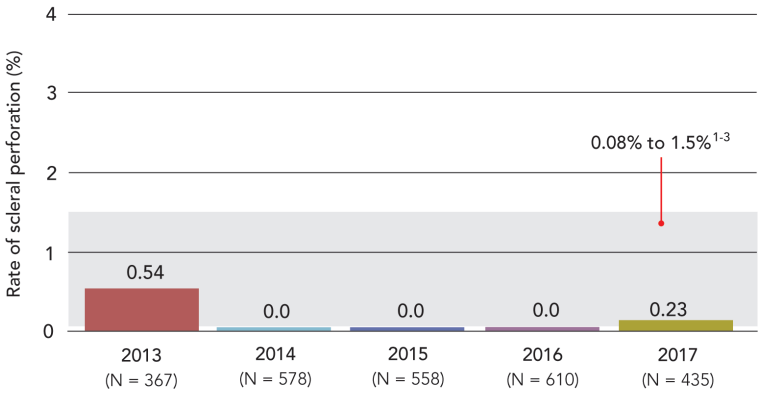


**Includes bacterial meningitis, coloboma, CFEOM (type 1), glaucoma, middle cerebral artery infarct, unilateral cataract, orbital fracture, and retinopathy of prematurity.*

Scleral Perforation During Strabismus Surgery

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 lead to retinal detachment in some cases.

Of the 435 strabismus procedures performed in 2017, there was one (0.23%) scleral perforation.



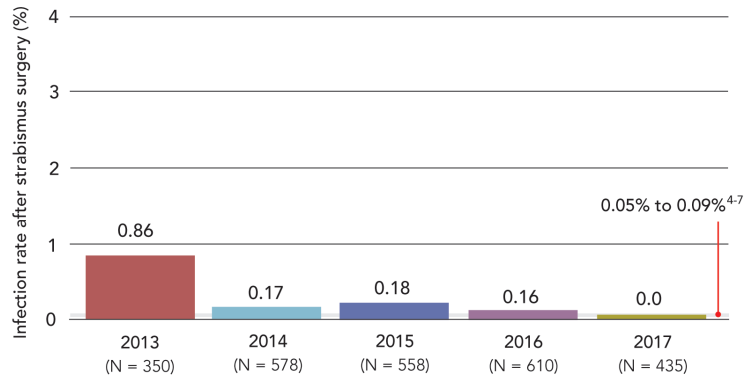
References: [1]Bradbury JA. What information can we give to the patient about the risks of strabismus surgery. Eye (Lond) 2015; 29(2): 252-257. [2]Awad AH, Mullaney PB, Al-Hazmi A, et al. Recognized globe perforation during strabismus surgery: incidence, risk factors, and sequelae. J AAPOS 2000; 4(3): 150-153. [3]Morris RJ, Rosen PH, Fells P. Incidence of inadvertent globe perforation during strabismus surgery. Br J Ophthalmol 1990; 74(8): 490-493.

Infection Within 30 Days after Surgery

Intra- or extraocular surgery may be complicated by postoperative infection. The types of infection after strabismus surgery that were included in this analysis were endophthalmitis, sub-Tenon's space abscess, subconjunctival abscess, and cellulitis.

In calendar year 2017, there were no post-operative infections reported for strabismus surgery. In calendar years 2013, 2014, 2015, and 2016, three of 350 strabismus procedures were complicated by orbital cellulitis, one of 578 procedures was complicated by a suture abscess, one of 558 was complicated by a post-operative pre-septal cellulitis, and one of 610 procedures was complicated by post-operative pyomyositis of an extraocular muscle, respectively.

There were no post-operative infections for pediatric cataract and ptosis surgery in calendar year 2017, which has been consistent since reporting began in 2013.[8-11]



References: [4]Ing MR. Infection following strabismus surgery. J Ophthalmic Nurs Technol 1991; 10(5): 211-214. [5]Bradbury JA. What information can we give to the patient about the risk of strabismus surgery. Eye (Lond) 2015; 29(2): 252-257. [6]Brenner C, Ashwin M, Smith D, et al. Sub-Tenon's space abscess after strabismus surgery. J AAPOS 2009; 13(2): 198-199. [7]Bradbury JA, Taylor RH. Severe complications of strabismus surgery. J AAPOS 2013; 17(1): 59-63. [8]Haripriya A, Chang DF, Reena M, et al. Complication rates of phacoemulsification and manual small-incision cataract surgery at Aravind Eye Hospital. J Cataract Refract Surg. 2012; 38(8): 1360-1369. [9]Sharma N, Pushker N, Dada T, et al. Complications of pediatric cataract surgery and intraocular lens implantation. J Cataract Refract Surg.1999; 25(12): 1585-1588. [10]Pandey SK, Wilson ME, Trivedi RH, et al. Pediatric cataract surgery and intraocular lens implantation: current techniques, complications, and management. Int Ophthalmol Clin 2001; 41(3): 175-196. [11]Lee EW, Holtebeck AC, Harrison AR. Infection rates in outpatient eyelid surgery. Ophthal Plast Reconstr Surg 2009; 25(2): 109-110.

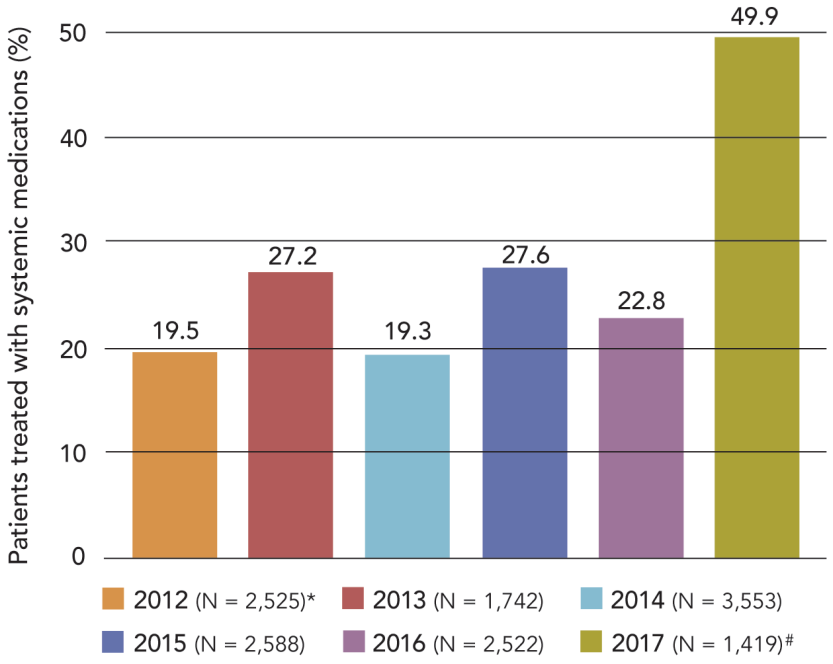
Ocular Immunology and Uveitis Service

Treatment for uveitis 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 eye drops, prescription NSAIDs, and systemic immunosuppressive medications. In general, the use of systemic immunomodulatory therapy is an indicator of increased severity.

Percentage of Patients on Systemic Immunomodulatory Therapy

The Mass. Eye and Ear Ocular Immunology and Uveitis Service saw a total of 1,419 patients with a diagnosis of non-infectious uveitis over 3,564 office visits during the 2017 calendar year.

Of the 1,419 patients seen in 2017, 708 patients (49.9%) were treated for ocular inflammation with some form of systemic medication, ranging from prescription oral nonsteroidal anti-inflammatory drugs (NSAIDs) (e.g. ibuprofen, naproxen, etc.) to oral corticosteroids (e.g. prednisone) to immunosuppressive agents (e.g. methotrexate, mycophenolate mofetil).



*Data reported for the 2012, 2014, 2015, and 2016 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.

#Data reported for calendar year 2017 include only patients that had non-infectious uveitis seen by the Ocular Immunology and Uveitis Service at any Mass. Eye and Ear location. This change was made to more accurately reflect our patient population with uveitis. The exclusion of patients without uveitis disease, changing our denominator, leads to the reported increased rate of patients on systemic medications.

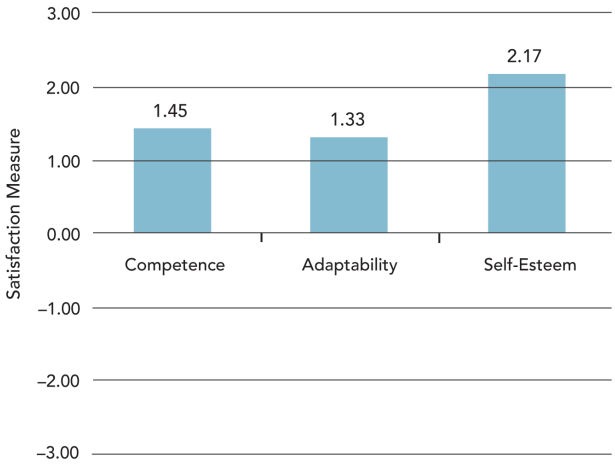
Vision Rehabilitation Service

The Mass. Eye and Ear Vision Rehabilitation Service offers multidisciplinary, comprehensive, and personalized treatment for patients with low vision. Interventions address difficulties with reading, activities of daily living, patient safety, continued participation in activities despite vision loss, and psychosocial adjustment to low vision.

Psychosocial Impact of Assistive Devices Scale (PIADS)

During calendar year 2017 there were 636 new vision rehab patients. Eleven percent of these new patients (n=70) took part in the PIADS questionnaire looking at the impact of a newly prescribed assistive device (i.e. smart glasses or hand held magnifying device). The PIADS questionnaire is a tool increasingly used by Vision Rehabilitation providers to track the impact of various assistive devices on a patient's quality of life.[1-2]

The PIADS questionnaire poses a series of questions to each patient, and based on their answer, an integer on a scale from -3 to +3 is recorded for various categories that pertain to daily life. A score of -3 would mean that the device had a strong negative impact in that category, a score of +3 would mean that the device had a strong positive impact, and a score of 0 would be neutral. The averages of the three main categories- competence, adaptability, and self-esteem- are shown in the graph. All three categories reported positive impact values for new patients who received a new vision device.



Published mean PIADS scores in an article specific to 68 CCTV users (a type of electronic magnifier) were 1.21, 0.76, and 0.99 for competence, adaptability, and self-esteem, respectively.[3] Of the 70 patients who took part in the questionnaire at the Mass. Eye and Ear Vision Rehabilitation Service, 23 used an electronic magnifying device. Average PIADS scores of these 23 patients were 2.02, 2.01, and 1.65 for competence, adaptability, and self-esteem, respectively, which all exceed these benchmark values.

(Left) Image of a patient using a vision assistive device that magnifies text on a page.

Photo by Pierce Harman.

[1]Jutai J, Day H. Psychosocial Impact of Assistive Devices Scale (PIADS). Technology and Disability. 2002; 14:107-111. [2]Garry G, Casey K, et al. A pilot study of eye tracking devices in intensive care. Surgery. 2016; 159(3): 938-944. [3]Huber JG, Jutai, JW, et al. The Psychosocial Impact of Closed-Circuit Televisions on Persons with Age-Related Macular Degeneration. J Vis Impair Blind. 2008; 102(11): 690-701.

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continued on page 50

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Department	Description of Change Compared to Prior Years
EMERGENCY DEPARTMENT	
Ophthalmology Visit Times, "Left Without Being Seen"	Initial and follow-up visits were included in the current analysis. Last year's analysis only included initial encounters.
Distribution of Ophthalmology Diagnoses	The top 20 urgent diagnoses seen in the Emergency Department are listed after analysis of all diagnoses made for every encounter.
GLAUCOMA SURGERY	
Glaucoma Surgery: Intraoperative Complications, Trabeculectomy Reoperation Rates	All pediatric cases were excluded.
CORNEA SURGERY	
Keratoplasty Surgery: Distribution, Surgical Indications for Penetrating Keratoplasty, Clear Corneal Grafts After Penetrating Keratoplasty, Clear Corneal Grafts After Partial Thickness Keratoplasty	All pediatric cases were excluded.
NEURO-OPHTHALMOLOGY SERVICE	
Demographics of Adult Strabismus Surgery Patients	Removed in favor of quantitative metrics.
Number of Muscles Operated on Per Patient Having Adult Strabismus Surgery	Removed in favor of quantitative metrics.
Success Rates for Adult Strabismus Surgery	Cases with less than 1 month follow-up data were excluded from the analysis.
OCULAR IMMUNOLOGY AND UVEITIS SERVICE	
Percentage of Patients on Systemic Immunomodulatory Therapy	Only patients that had non-infectious uveitis were included in the current analysis. Previous years' analyses included all patients seen by the Ocular Immunology and Uveitis Service.
VISION REHABILITATION SERVICE	
Psychosocial Impact of Assistive Devices Scale (PIADS)	New outcome measure.
Patient Experience Ratings	Removed in favor of quantitative metrics.

Photo by Garyfallia Pagonis.