

# Quality and Outcomes

Department of Ophthalmology | 2019



Photo by Gulnara Niaz and Pierce Harman.



MASSACHUSETTS  
EYE AND EAR

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Massachusetts  
Eye and Ear  
Infirmity

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

Dear Colleagues in Health Care,

**T**hank you for reading the 2019 edition of the Mass. Eye and Ear Quality and Outcomes Report for the Department of Ophthalmology. This year's book represents a special milestone: 10 years of consistent reporting on specific outcomes measures throughout the field of ophthalmology. I am very proud that Mass. Eye and Ear has led the nation in defining appropriate ophthalmology measures, collecting data, and publishing that data with complete transparency. I continue to hope that more organizations and providers will join us in this effort to engage in public reporting. As you will read in the pages that follow, Mass. Eye and Ear has enhanced its quality efforts with a renewed focus on the patient's overall experience, an effort we expect to sustain for decades to come.

This tenth edition reflects the meticulous work of many contributors, some who have participated since 2010. First, we thank Dr. Joan Miller, Chief and Chair of the Department of Ophthalmology at Mass. Eye and Ear, Mass General, and Harvard Medical School, for her leadership in setting the national standard in ophthalmology outcomes reporting. We also thank Dr. Alice Lorch, Chief Quality Officer for Ophthalmology, for her devotion and leadership in this project. Dr. Matthew Gardiner, Associate Director of Quality for Ophthalmology plays a significant advisory role and we are grateful to all of the clinicians, technicians, nurses and staff members at Mass. Eye and Ear, who provide the highest quality care to our patients each and every day.

For more information on the Mass. Eye and Ear quality program and to view an electronic copy of this report, please visit our website at [MassEyeAndEar.org](http://MassEyeAndEar.org).



**John Fernandez**  
President  
Massachusetts Eye and Ear

## About the Quality and Outcomes Program



Photo by Garyfallia Pagonis.

**T**his year, Mass. Eye and Ear kicked off a hospital-wide, multi-year initiative called “All About You,” intended to put the patient at the center of every decision. The initiative is made up of five patient experience teams each focused on one of these areas: patient access, patient communication, clinic operations, staff engagement, and compensation and incentives. The work on the patient experience complements our work in quality and outcomes. Together, we strive to improve the care and experience of each and every patient.

Each year, we look critically at the outcomes metrics that we have chosen for each subspecialty to ensure that they are clinically relevant. On an annual basis, we hone our methodology, moving towards automated data collection that will eventually allow us to look at these metrics in real-time. We do all of this to identify areas in which we can improve patient safety and quality of health care and then intervene through quality improvement projects. This year, for example, we noticed that our rates of documented communication of imaging results to patients in Neuro-Ophthalmology continued to decrease. We believe that patients deserve to hear their imaging results from their physician as soon as possible, ideally within 48 hours. A root cause analysis suggested that communications that are taking place are not being captured accurately due to difficulty with a new electronic medical record. We are working to modify the electronic medical record to more easily allow physicians to document these crucial patient communications.

In addition to providing longitudinal data over time for long-standing metrics, we continue to think creatively about important metrics to add to our analyses to ensure excellent patient care. This year, we have data for the first time on SMILE refractive procedures, which we are performing with increasing frequency. Other new metrics include visual acuity following treatment for open globe injuries relative to Ocular Trauma Score, and visual acuity following treatment for uveitis. In future years, we plan to continue to add metrics for newer treatments and procedures, such as Optiwave Refractive Analysis (ORA) guided cataract surgery seen highlighted on the cover.

We strive at Mass. Eye and Ear to provide each and every patient with the highest quality medical care, and this publication is one of the ways that we monitor and ensure that care in the Department of Ophthalmology.

We want to thank research assistants Mirjana Nordmann, PhD, Colleen Szytko, and Thong Ta for their work on this year's book. In the coming years, we are excited by the prospect of expanding this publication. We hope that you find this information useful, and we welcome your comments and feedback.



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## Ophthalmology Clinical Leadership in Quality: 2019

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## About Massachusetts Eye and Ear

**F**ounded in 1824, Massachusetts Eye and Ear is a preeminent 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, 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 200 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.

### 2018 Ophthalmology and Otolaryngology Hospital Statistics

(January 1 – December 31, 2018)

#### Patient Volume

*All services at Mass. Eye and Ear locations.*

Outpatient Services*	523,243
Ambulatory Surgery Services	31,050
Inpatient Surgical Services^	974
Emergency Department Services	21,091
Discharges	1,150
Beds	41
Overall Operating Revenue#	\$459,742,349

\*All clinic visits, Ambulatory Surgery Services, Emergency Department Services, and Discharges

^Includes community-based physicians

#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](http://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 Berman-Gund Laboratory for the Study of Retinal Degenerations, Howe Laboratory, and Schepens Eye Research Institute of Mass. Eye and Ear.
- Accelerating research and discovery through our Harvard Ophthalmology Institutes and Centers of Excellence:

Age-Related Macular Degeneration Center of Excellence  
 Cornea Center of Excellence  
 Diabetic Eye Disease Center of Excellence  
 Glaucoma Center of Excellence  
 Infectious Disease Institute  
 Mobility Enhancement & Vision Rehabilitation Center of Excellence  
 Ocular Genomics Institute  
 Ocular Oncology Center of Excellence  
 Ocular Regenerative Medicine Institute

### Academic Affiliations and Partners

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  
 LV Prasad Eye Institute, Hyderabad, India  
 Shanghai Eye and ENT Hospital: Fudan University, Shanghai, China

### Clinical Affiliations

#### Massachusetts General Hospital

- Mass. Eye and Ear clinicians provide comprehensive and subspecialty care to Mass General 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 Mass General patients as a more affordable and efficient alternative to Emergency Department care.

### **Brigham and Women's Hospital (BWH) and Brigham and Women's Faulkner Hospital (BWFH)**

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

### **Children's Hospital Ophthalmology Foundation (CHOF)**

- CHOF clinicians staff the comprehensive pediatric ophthalmology and adult strabismus service at Mass. Eye and Ear and Mass General.
- Mass. Eye and Ear ophthalmologists provide subspecialty care in glaucoma, cornea, and pediatric retina surgery through CHOF.

### **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, swept source optical coherence tomography, fluorescein angiography, indocyanine green angiography, and 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 imaging.
- The David G. Cogan Laboratory of Ophthalmic Pathology provides enhanced diagnostic services in conjunction with the Mass General Surgical Pathology Service.
- The Mass. Eye and Ear Infectious Disease Service 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 Contact Lens Service specializes in therapeutic lens fittings, bandage contact lenses, 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](http://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 helps patients with appointments, transportation, accommodations, and language translation.
- The Altschuler Surgical Training Laboratory serves as a cornerstone of the surgical training program at Harvard Ophthalmology/Mass. Eye and Ear, 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, a Harvard University library, houses one of the most extensive ophthalmology research collections in the world. The library also collaborates with institutions, including The Francis A. Countway Library of Medicine at Harvard Medical School, the National Library of Medicine, and Association of Vision Science Libraries.

## Mass. Eye and Ear Ophthalmology Associates Key Statistics

(January 1–December 31, 2018)

Subspecialty	Patient Visits
<b>Outpatient Ophthalmology Encounters</b>	
Comprehensive Ophthalmology and Cataract Consultation.....	50,697
Trauma.....	662
Cornea.....	21,371
Optometry.....	12,829
Ophthalmic Plastic and Reconstructive Surgery.....	10,577
Glaucoma.....	25,818
Immunology and Uveitis.....	5,634
Inherited Retinal Disorders.....	1,334
Neuro-Ophthalmology.....	6,276
Retina.....	46,247
Vision Rehabilitation.....	1,202
Total Outpatient Ophthalmology Visits.....	182,647
<b>Emergency Department Visits</b>	
Total Ophthalmology Visits.....	16,077
<b>Surgical Procedures</b>	
Total Ophthalmology Surgeries*.....	13,485
Total Ophthalmology Laser Procedures*.....	3,502
Refractive Procedures*.....	466
Total Intravitreal Injections.....	17,277
Total Ophthalmology Procedures.....	34,730

\*Includes community-based physicians

Data reported throughout the book for 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, and 2018 represent calendar years. The 2009 data represent 12-month results as noted.

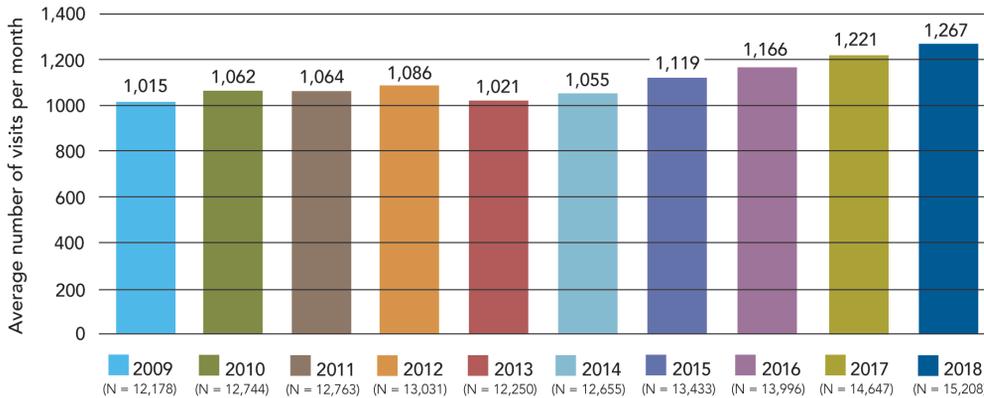
All benchmarks reported reflect the most recent values in literature.

## 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 Mass General Emergency Department to co-manage and coordinate care for patients with ophthalmic problems.

### Ophthalmology Emergency Visits

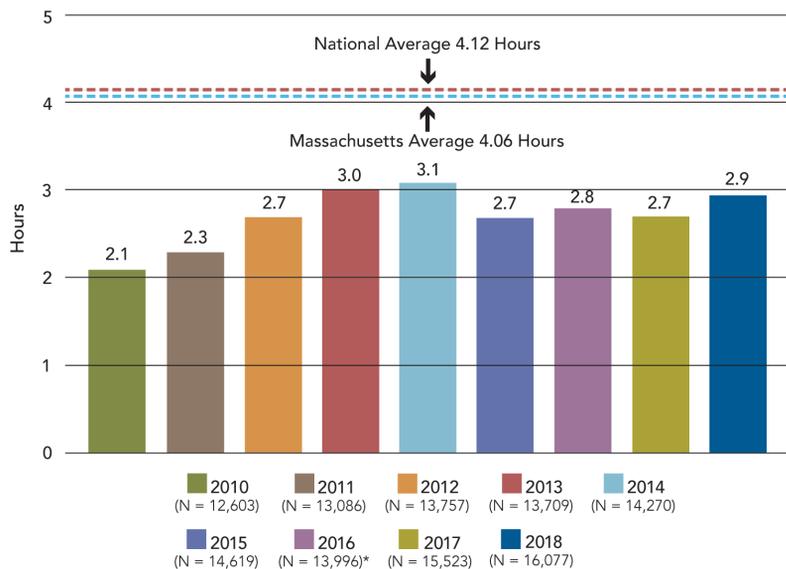
This bar graph shows the average number of ophthalmology initial encounters seen monthly by the Mass. Eye and Ear Emergency Department across the last 10 calendar years.



### Ophthalmology Visit Times

The average ophthalmology visit time in the Mass. Eye and Ear Emergency Department for calendar year 2018 was 2.9 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 left the Emergency Department. Visit times over three 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 department visit. The Massachusetts state average visit time was 4.06 hours.

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

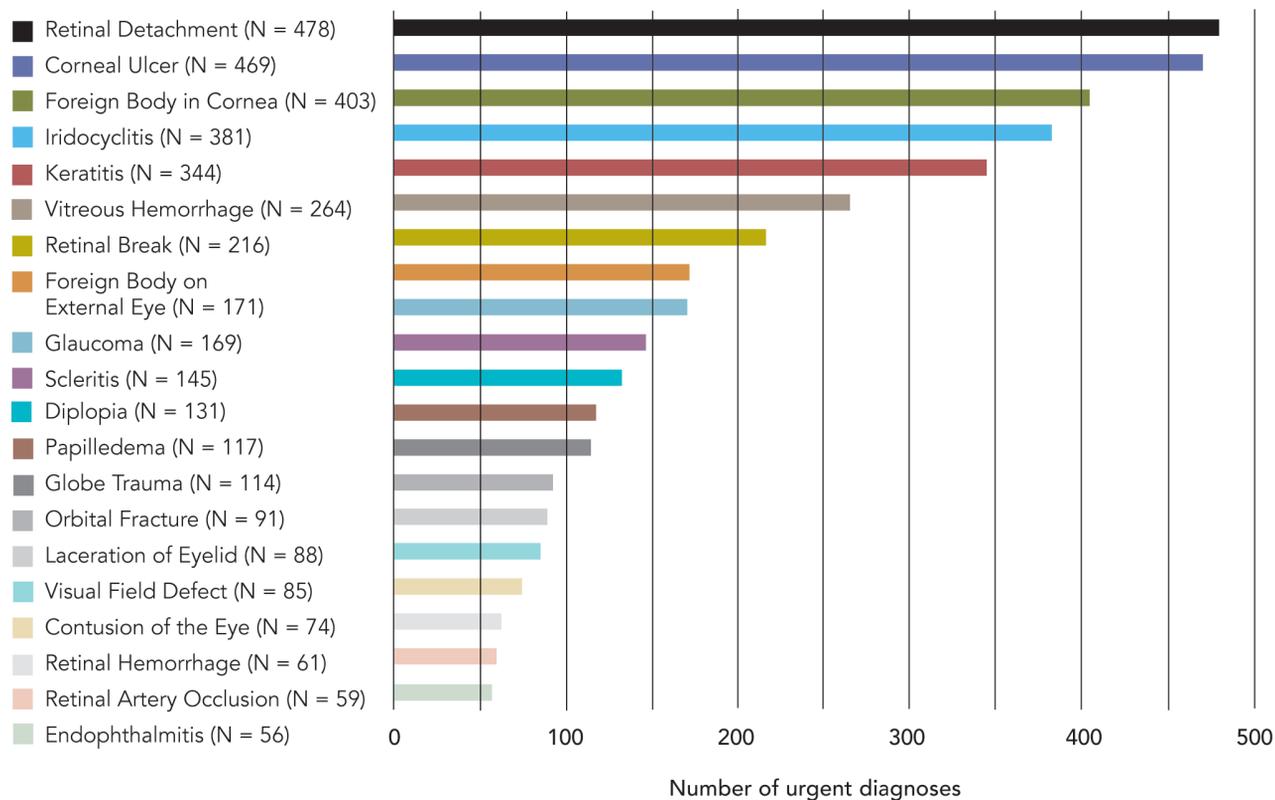


\*For calendar year 2016, the graphed data depicts only initial encounters.

## Distribution of Top 20 Urgent Ophthalmology Diagnoses

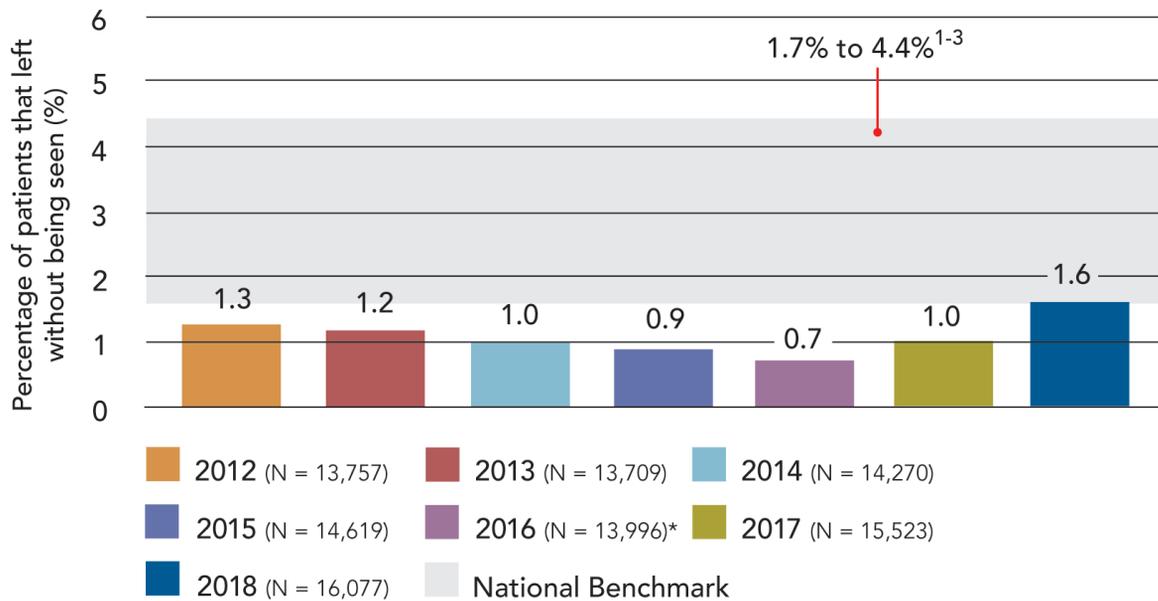
During calendar year 2018, there were 15,208 ophthalmic emergency initial encounters to the Mass. Eye and Ear Emergency Department. Of these, 4,259 were associated with primary urgent diagnoses. The top 20 urgent diagnoses represented 3,916 (25.7%) of the total Emergency Department initial encounters and are depicted below and ranked according to their frequency.

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



## 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 1.6% (250 patients for all 16,077 initial and follow-up ophthalmic emergency encounters) in calendar year 2018. According to a 2009 report by the Society for Academic Emergency Medicine, the national LWBS rate is 1.7%.<sup>1</sup> LWBS rates vary greatly between hospitals; a review of the literature suggests a national range of 1.7% to 4.4%.<sup>1-3</sup>



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

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

References: <sup>1</sup>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. *Acad Emerg Med* 2009; 16(10): 949-955. <sup>2</sup>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. <sup>3</sup>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.

## Eye Trauma Surgery



The Eye Trauma Service at Mass. Eye and Ear provides high-quality and successful surgical care for patients with open globe injuries from throughout New England.

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

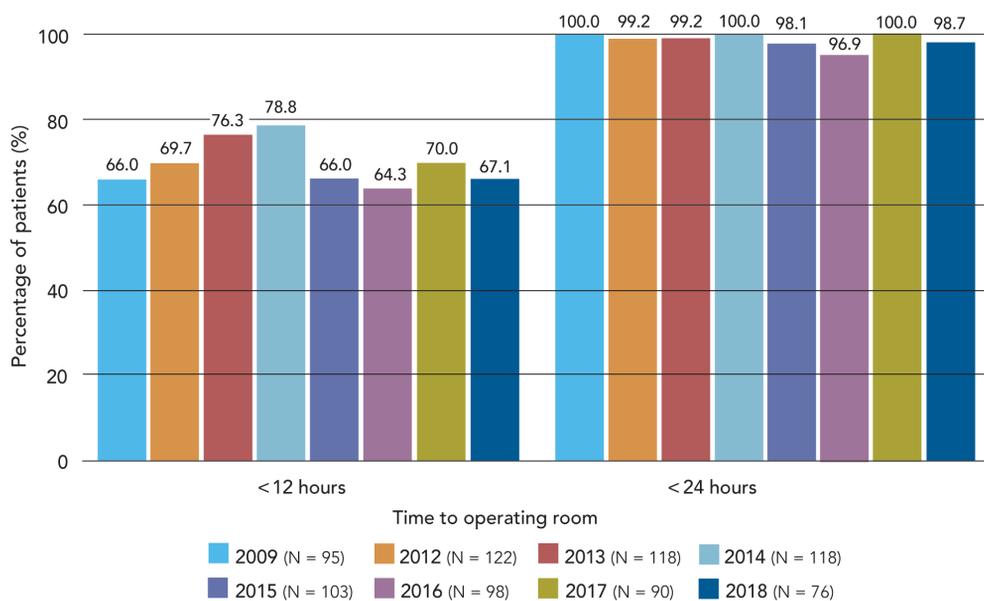
*Photo courtesy of Alice Lorch, MD, MPH*

### Time to Surgical Repair for Open Globe Injuries

During calendar year 2018, 97 open globe injuries requiring repair presented to the Eye Trauma Service. There were an additional 11 cases where an exploration was performed and no repair was needed. Of the 97 repaired injuries, 10 cases involving intraocular foreign bodies in the posterior segment were repaired by the Retina Service, 10 dehisced penetrating keratoplasties were repaired by the Cornea Service, and one was repaired by the Oculoplastics Service; these were not included in the analysis. Seventy-six patients suffered open globe injuries that required urgent surgical repair by the Eye Trauma Service. Of these 76 patients, 75 (98.7%) were taken to the operating room within 24 hours of arrival at Mass. Eye and Ear. Fifty-one of the 76 patients (67.1%) were taken to the operating room in under 12 hours. One patient was taken to the operating room more than 24 hours after admission because of a delay in anesthesia clearance due to patient intoxication.

The mean time from presentation at the Emergency Department to arrival in the operating room was 9.08 hours (range: 2.25 to 25.97 hours).

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

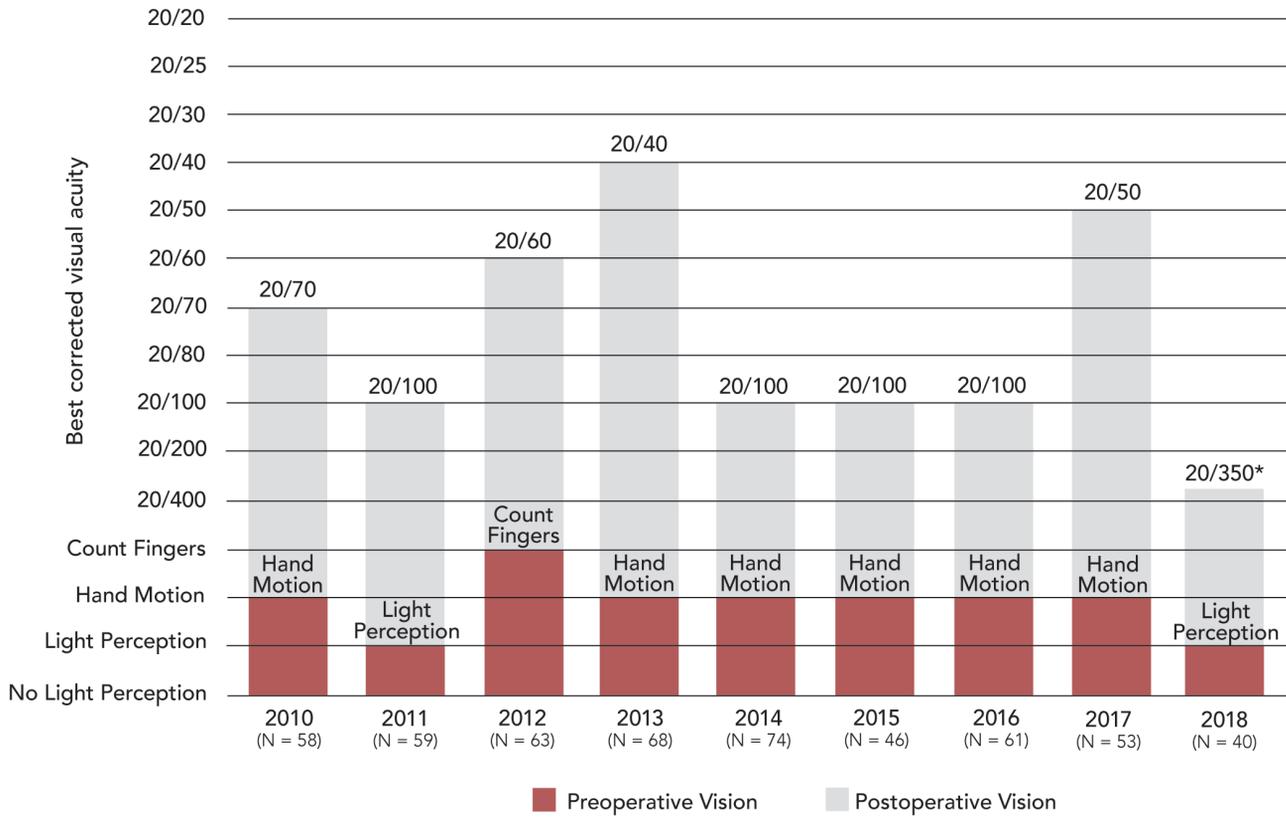


In calendar year 2018, the Eye Trauma Service repaired 98.7% of presenting open globe injuries within 24 hours after presentation to Mass. Eye and Ear. This rate is similar to prior years.

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

### Median Postoperative Vision

During the 2018 calendar year, 76 eyes of 76 patients had open globe repair by the Mass. Eye and Ear Eye Trauma Service. Of these 76 patients, visual acuity at presentation was recorded in 73 patients. Visual acuity was not possible in three patients due to their mental status. At the time of analysis, 40 patients had a follow-up visit between four and six months following surgery. Data from these individuals was analyzed for preoperative and postoperative vision. During the 2018 calendar year, the median preoperative vision was "light perception," and the median postoperative vision at a follow-up visit four to six months after repair was 20/350.



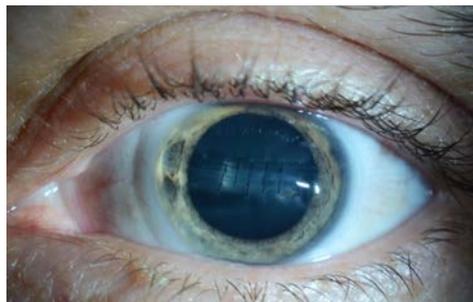
\*A stricter follow-up window of at least four but no more than six months was in place for 2018.

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.<sup>1</sup>

Reference: <sup>1</sup>Shah AS, Andreoli MT, Andreoli CM, et al. Pediatric open-globe injuries: a large scale, retrospective review. Poster presented 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.

## Final Visual Acuity and Ocular Trauma Score

Patients that undergo open globe repair in the Mass. Eye and Ear Eye Trauma Service often do not return for follow-up within the four to six month postoperative period in which we collect data on median visual acuity outcomes; this can be due to factors such as geography and quick recoveries. To capture the outcomes of more cases, this analysis presents the final visual acuity for all patients with a minimum of one week of follow-up as a function of their respective ocular trauma score (OTS).



Postoperative left eye following an open globe injury and repair.

Photo courtesy of Grayson Armstrong, MD, MPH

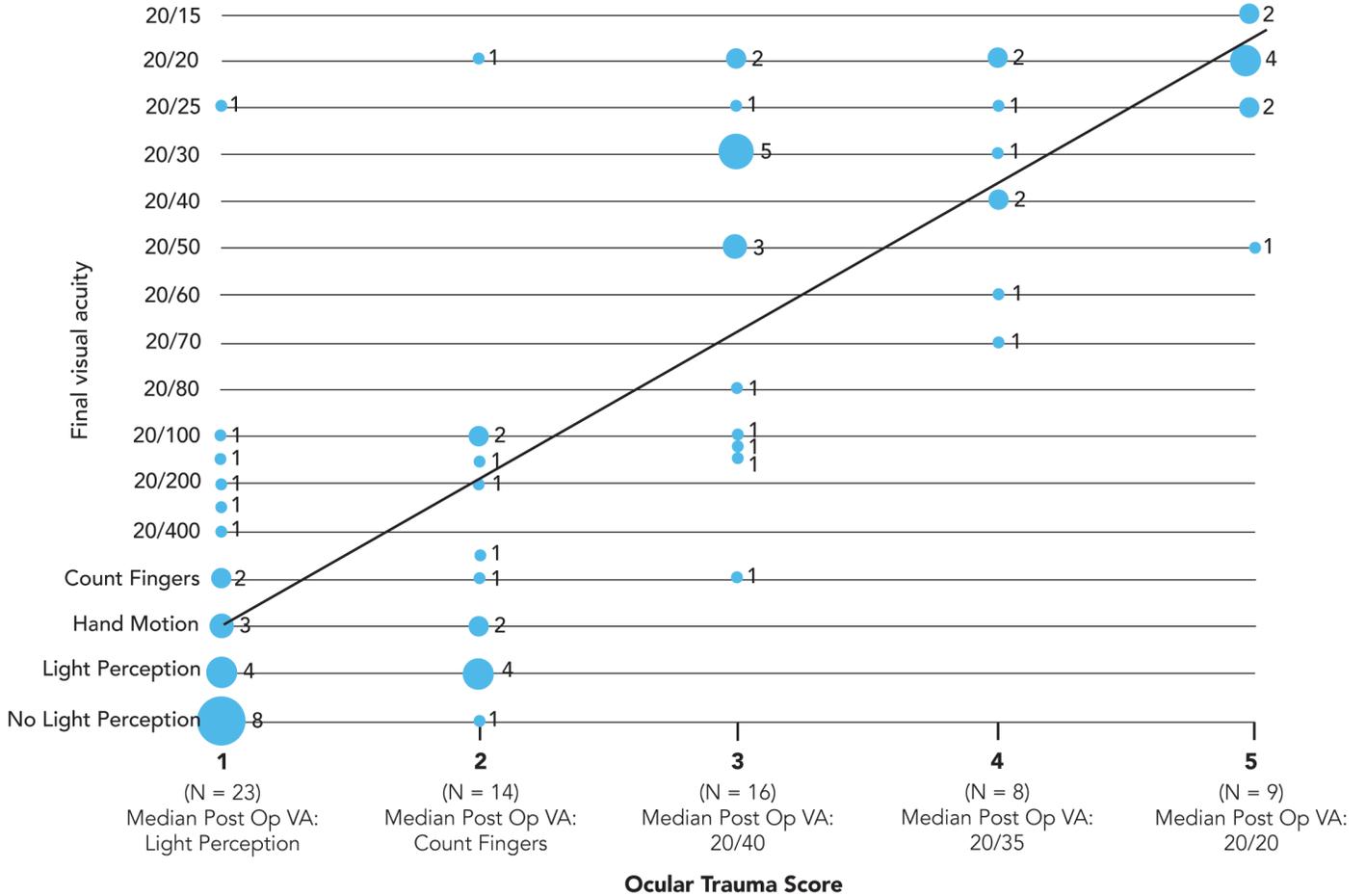
OTS, a commonly used predictor in ocular trauma management, categorizes patients by the severity of open globe injury. This score accounts for the patient's visual acuity at presentation and other preoperative findings, such as the mechanism of the open globe injury and the presence or absence of relative afferent pupillary defect. To calculate a patient's score, all the raw points corresponding to the presenting variables are added; the final sum corresponds to the OTS. A higher ocular trauma score predicts a better visual outcome.<sup>1</sup>

Variables	Raw Points	Sum of raw points	OTS
Initial vision		0-44	1
NLP	60	45-65	2
LP/HM	70	66-80	3
1/200-19/200	80	81-91	4
20/200-20/50	90	92-100	5
≥20/40	100		
Rupture	-23		
Endophthalmitis	-17		
Perforating Injury	-14		
Retinal detachment	-11		
Afferent pupillary defect	-10		

For design purposes, these tables have been adapted from their original publication.<sup>1</sup>

### Final Visual Acuity and Ocular Trauma Score

During the 2018 calendar year, 76 patients had an open globe injury repaired by the Mass. Eye and Ear Eye Trauma Service. Of these, 70 patients who had a recorded visual acuity at presentation and at least one week of follow-up at Mass. Eye and Ear were included in the analysis. The most recent visual acuity in the one week to six months window following surgery was recorded for each patient. Of the 37 patients that presented with extensive injuries to the globe (OTS 1 or 2), 29.7% (11/37) had a final visual acuity of 20/400 or better. Of the remaining 33 patients that presented with ocular trauma scores 3 to 5, 78.8% (26/33) had final visual acuities ranging from 20/50 to 20/15.

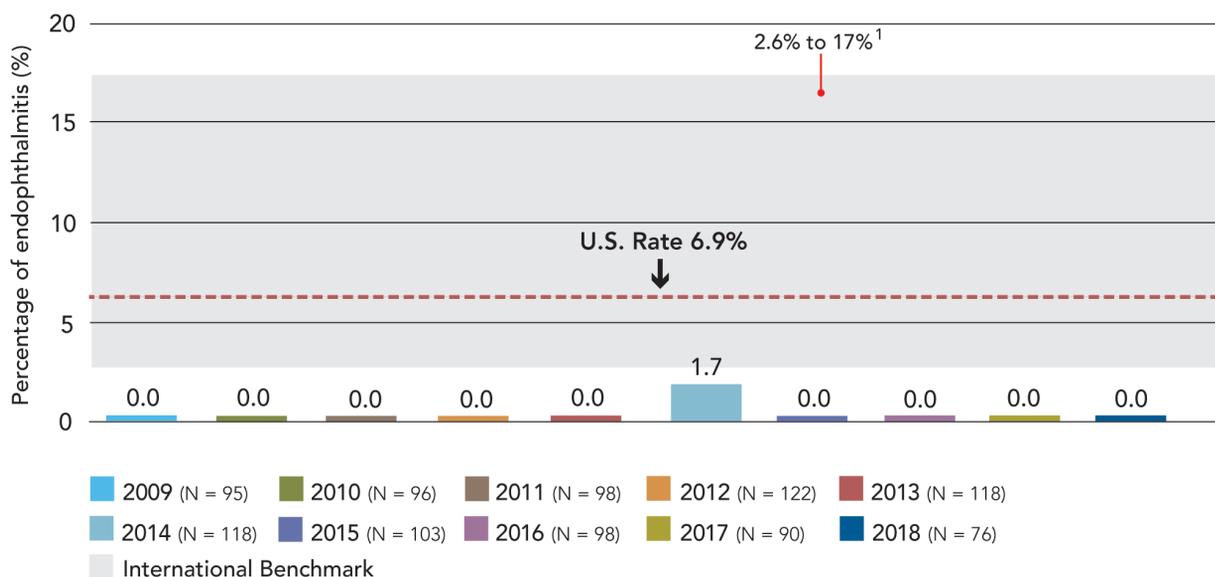


## Rates of Endophthalmitis After Open Globe Repair

During calendar year 2018, 76 patients underwent open globe repair by the Mass. Eye and Ear Eye Trauma Service. Of these 76 patients, zero (0%) developed endophthalmitis within 30 days of surgery. Similar results were reported since 2009.

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.<sup>1</sup>

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).<sup>1</sup> 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.<sup>1</sup>



## Cataract Surgery

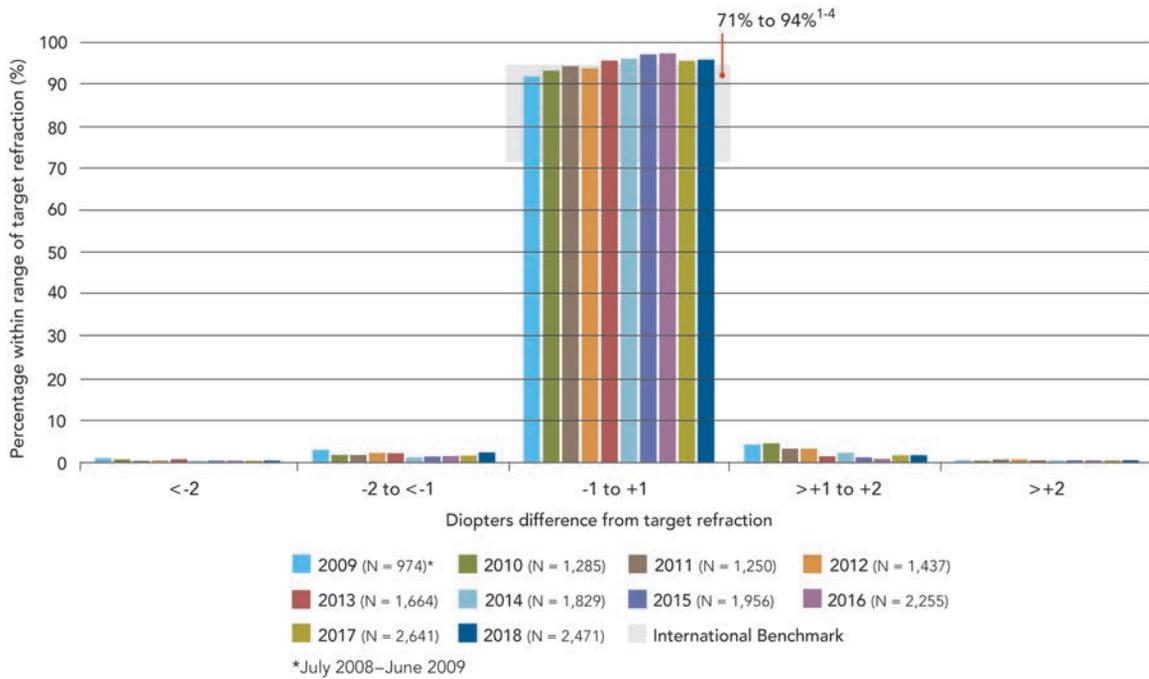
The Comprehensive Ophthalmology and Cataract Consultation Service at Mass. Eye and Ear provides a full spectrum of integrated patient care, including annual and diabetic eye exams, prescriptions for eyeglasses, management of a variety of chronic eye problems, surgical intervention, and subspecialty referrals 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 2018 calendar year, the Comprehensive Ophthalmology and Cataract Consultation Service performed cataract surgery on 2,876 eyes. This chart depicts the results of the 2,471 eyes with follow-up data available between three weeks and three months postoperatively. Of these 2,471 eyes, 95.9% (2,369/2,471) achieved within one diopter of target refraction, and 78.2% (1,932/2,471) achieved within 0.5 diopter of target refraction after cataract surgery.



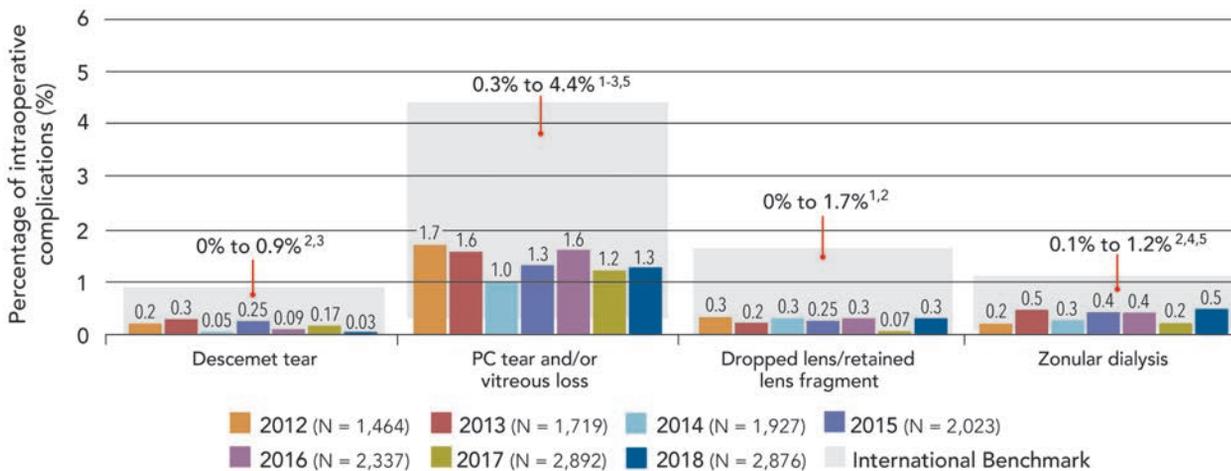
For the past 10 years, the Comprehensive Ophthalmology and Cataract Consultation Service has consistently met or exceeded international benchmarks for successful cataract surgery.

References: <sup>1</sup>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. <sup>2</sup>Cole Eye Institute. Outcomes 2012. <sup>3</sup>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. <sup>4</sup>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 2,876 cataract surgeries performed by the Comprehensive Ophthalmology and Cataract Consultation Service during the 2018 calendar year at all surgical locations, 50 (1.7%) had intraoperative complications. These results are displayed in the graph below.

In addition, there were no cases of endophthalmitis within 30 days of cataract surgery in calendar year 2018.



### Mass. Eye and Ear 2018 Intraoperative Complication Rates

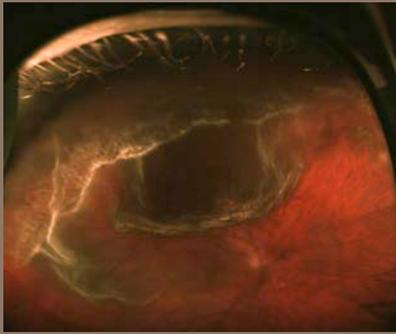
Complication	N (%)
Descemet tear	1 (0.03)
Posterior capsule (PC) tear and/or vitreous loss	38 (1.3)
Dropped lens/retained lens fragment	9 (0.3)
Zonular dialysis	15 (0.5)

Year	Overall Complication Rate (%)
2012	2.5
2013	2.6
2014	1.7
2015	1.8
2016	1.9
2017	1.6
2018	1.7

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

References: <sup>1</sup>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. <sup>2</sup>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. <sup>3</sup>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. <sup>4</sup>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. <sup>5</sup>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.

## Retina Surgery

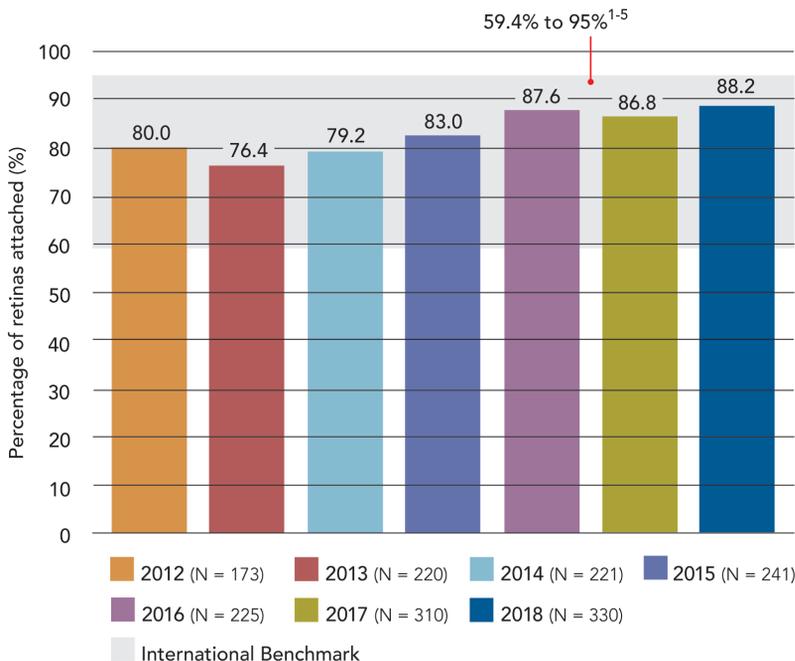


The Retina Service at Mass. Eye and Ear is one of the largest subspecialty groups of its kind in the country. Our clinicians are highly skilled at diagnosing and treating a full range of ocular conditions, including macular degeneration, diabetic retinopathy, retinal detachments, ocular tumors, intraocular 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 2018, the Mass. Eye and Ear Retina Service performed a total of 1,683 procedures, of which 906 were for retinal detachments (RDs). From these 906 cases, the following were excluded: chronic RDs of greater than one month duration; exudative and tractional RDs, RDs associated with proliferative vitreoretinopathy, macular holes, or trauma; prior pars plana vitrectomy; patients less than 18 years of age; cases associated with Marfan's or Stickler's syndrome; and cases with insufficient follow-up. After exclusion criteria were applied, 330 uncomplicated primary RRD surgeries remained for the following analysis. Single surgery reattachment rate, defined as an attached retina three months to five months post-operatively, was 88.2% (or 291 of 330 eyes). Similar results were reported for calendar years 2012 to 2017.

Benchmarks were determined from a literature review of studies that reported single surgery

reattachment rates for at least two of the three surgical techniques in this analysis (i.e., pneumatic retinopexy, pars plana vitrectomy, and/or scleral buckle).

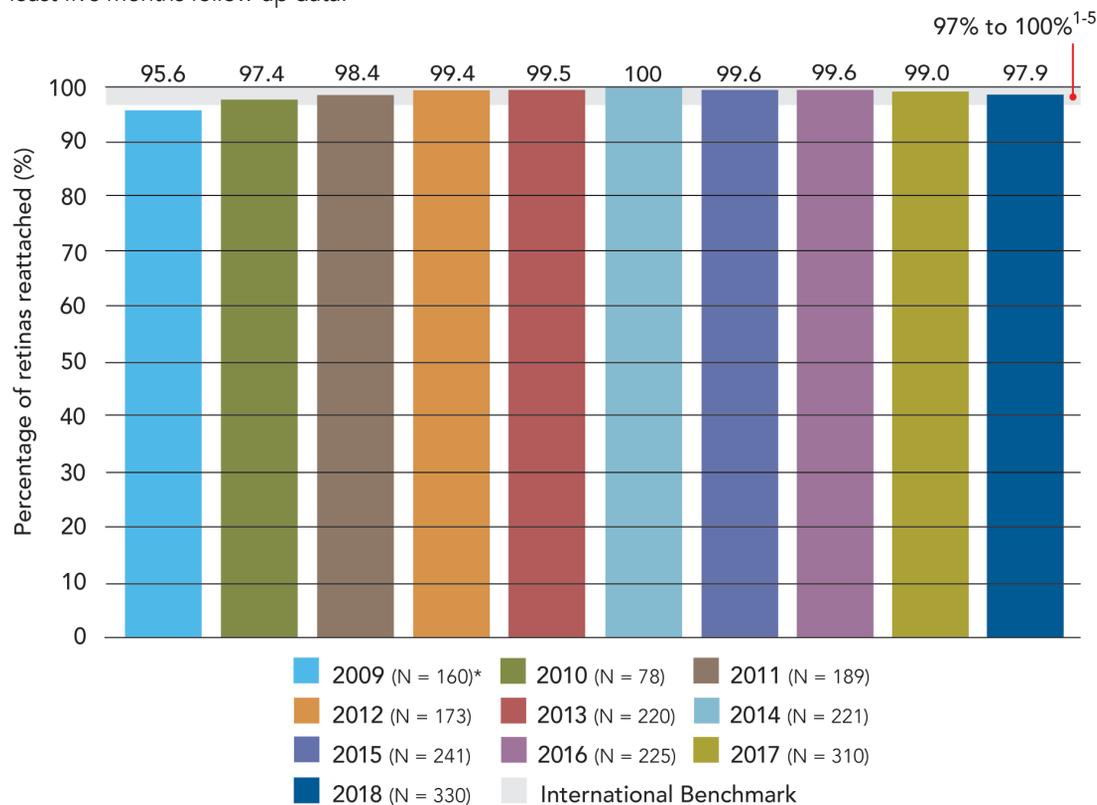
**Of the 330 included procedures for retinal detachments, 31 were pneumatic retinopexies. Of these, 51.6% had an attached retina after one surgery, and 90.3% had an attached retina after multiple surgeries. Of the remaining 299 procedures, which include scleral buckles and pars plana vitrectomies, 92.0% had an attached retina after one surgery, and 98.7% had an attached retina after multiple surgeries.**

References: <sup>1</sup>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. <sup>2</sup>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. <sup>3</sup>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. <sup>4</sup>Sodhi A, Leung LS, Do DV, et al. Recent trends in the management of rhegmatogenous retinal detachment. *Surv Ophthalmol* 2008; 53(1): 50-67. <sup>5</sup>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 2018, 330 uncomplicated primary RRD surgeries were analyzed to determine the final retinal reattachment rate.

Retinal reattachment was successfully achieved in 97.9% (323/330) of eyes. This reattachment rate reflects eyes that had one or more surgeries, which may have included pars plana vitrectomy, scleral buckle, and pneumatic retinopexy. These 330 eyes had at least three months of follow-up from the date of the last surgery; data were collected from visits closest to three but up to five months postoperatively. 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.



\*March 2008–February 2009

With a 97.9% reattachment 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 nine years, the Retina Service has consistently met international benchmarks of 97% to 100% for successful RRD repair.<sup>1-5</sup>

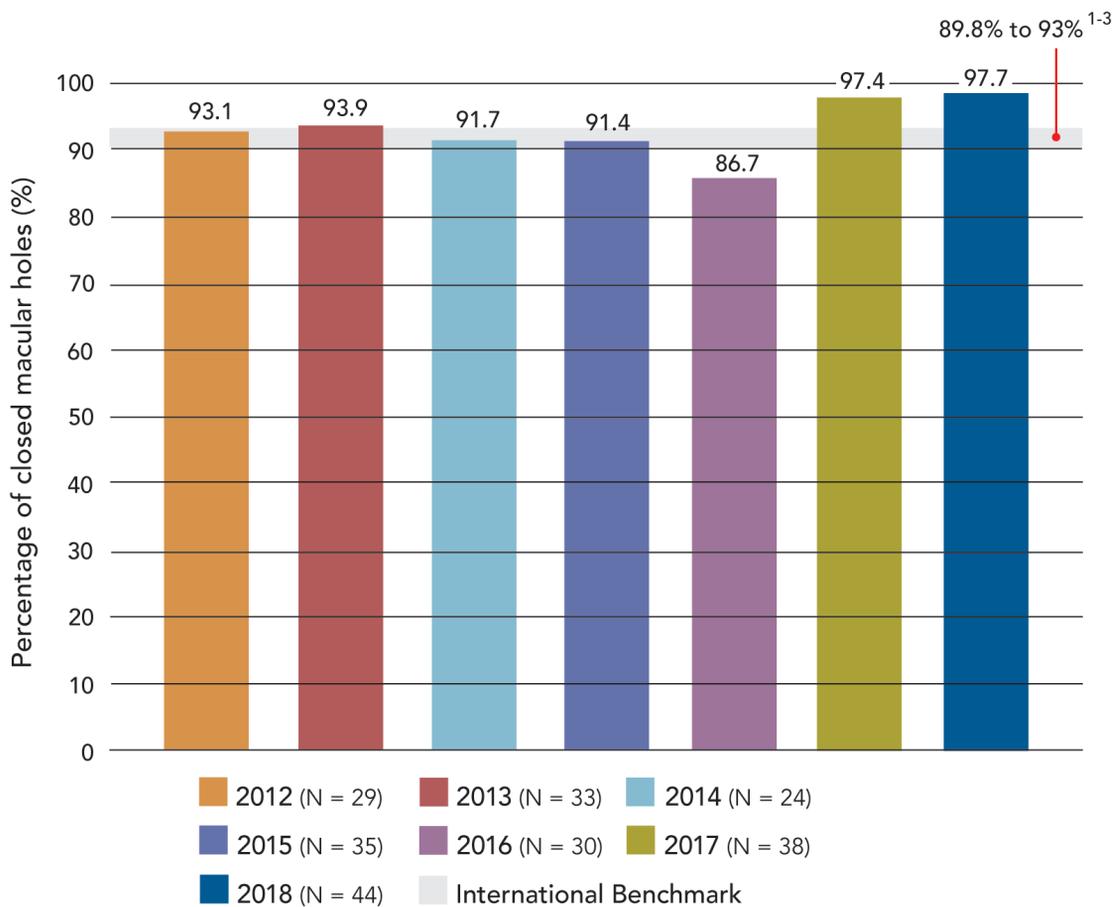
Of the three cases in 2017 that were detached at the time of analysis, one patient elected not to undergo further surgeries. The remaining two patients' retinas attached after five and three surgeries, respectively.

References: <sup>1</sup>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. <sup>2</sup>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. <sup>3</sup>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. <sup>4</sup>Sullivan PM, Luff AJ, Aylward GW. Results of primary retinal reattachment surgery: a prospective audit. *Eye* 1997; 11(Pt6): 869-871. <sup>5</sup>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.

## Macular Hole Surgery: Single Surgery Success Rate at Three Months

During calendar year 2018, the Mass. Eye and Ear Retina Service performed 95 macular hole surgeries. Of these 95 macular hole surgeries, the following were excluded: macular holes associated with RRD or trauma, holes with a history of prior pars plana vitrectomy, macular holes of greater than 6 months duration, and cases with insufficient follow-up. After exclusion criteria were applied, a total of 44 primary macular hole surgeries on 44 eyes (which included pars plana vitrectomy, membrane peel, and gas tamponade) were included in the following analysis.

Of the 44 eyes, 43 (97.7%) achieved surgical success with a single operation. Success was defined as any primary macular hole that was fully closed on an exam between three and five months following their 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%.<sup>1-3</sup> Of the 44 eyes included for analysis in calendar year 2018, 100.0% (44/44) achieved surgical success after one or two surgeries.



References: <sup>1</sup>Wu D, Ho LY, Lai M, et al. Surgical outcomes of idiopathic macular hole repair with limited postoperative positioning. *Retina* 2011; 31(3): 609-611. <sup>2</sup>Smiddy WE, Feuer W, Cordahi G. Internal limiting membrane peeling in macular hole surgery. *Ophthalmology* 2001; 108(8): 1471-1478. <sup>3</sup>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 2018 calendar year, the Mass. Eye and Ear Retina Service performed 17,277 intravitreal injections (IVIs). Of these, two cases of infectious endophthalmitis (0.01%) were identified after IVI.

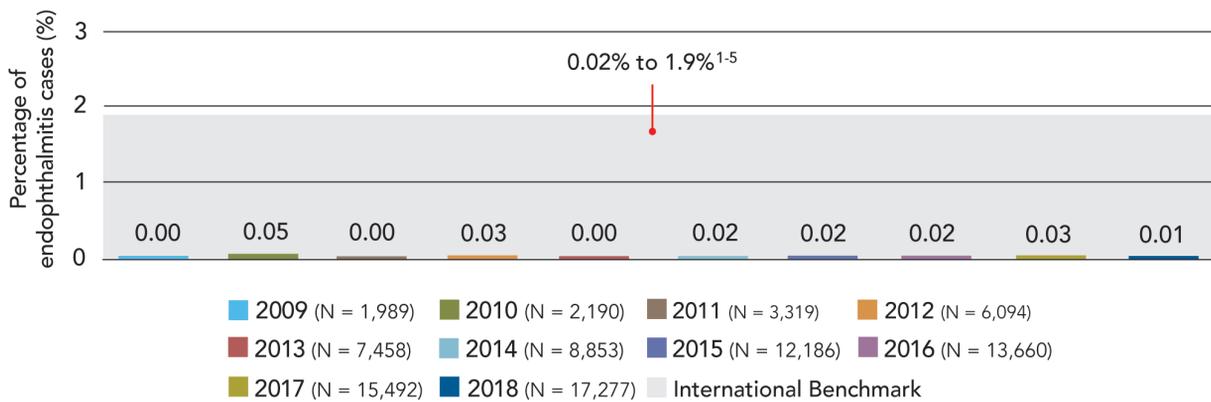
In the first case, the patient presented seven days after IVI with a visual acuity of 20/40 (pre-IVI vision was 20/30), anterior chamber and vitreous cells, and granulomatous keratic precipitates. The patient underwent a vitreous and an anterior chamber tap with injection of intravitreal vancomycin and ceftazidime on the same day. There was no growth in cultures. The patient's best corrected visual acuity was 20/40 at 10 months post-treatment.



Endophthalmitis of the right eye

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

In the second case, the patient presented five days after IVI with hypopyon with fibrin and a visual acuity of hand motion (pre-IVI vision was 20/40). Anterior chamber and vitreous taps were performed with an intravitreal injection of antibiotics (ceftazidime and vancomycin) along with a pars plana vitrectomy, anterior chamber washout, posterior synechiolysis, and second IVI of vancomycin and ceftazidime on the same day. Vitreous cultures were positive for *Enterococcus*. The patient's visual acuity was no light perception at three months post-treatment.



**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 2018 is similar to the overall rate for the past 10 calendar years (i.e. period from January 1, 2009 to December 31, 2018), where the overall rate of endophthalmitis after intravitreal injection was 0.02% (16 of 88,518 injections).**

References: <sup>1</sup>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. <sup>2</sup>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. <sup>3</sup>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. <sup>4</sup>VanderBeek BL, Bonaffini SG, Ma L. Association of compounded bevacizumab with postinjection endophthalmitis. *JAMA Ophthalmol* 2015; 133(10): 1159-1164. <sup>5</sup>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.

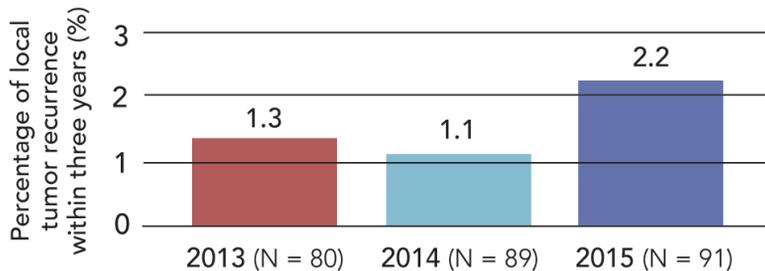
## Management of Intraocular Tumors: Tumor Recurrence After Proton Therapy

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 proton beam irradiation, achieving local control of the tumor in most cases, and preserving visual function in many patients. The service closely examines the recurrence rate at three years following treatment, and as such 2015 results are presented below.

Ninety-seven patients were diagnosed with uveal melanoma (UM) in calendar year 2015. Enucleation was performed in three cases, and 94 patients received proton beam irradiation. Ninety-one of these 94 patients returned for at least one follow-up visit and 45.1% (41/91) of these patients had three or more years (defined as a follow-up visit at 33 months or later) of follow-up. Median follow-up time was 31.6 months. By the end of 2018, two of the 91 patients (2.2%) developed recurrences at 11.2 and 11.8 months after proton irradiation. One patient had developed metastasis just prior to diagnosis of the recurrence and underwent systemic

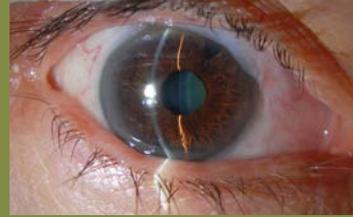
treatment for metastatic disease. This patient died of metastatic melanoma five months after developing metastasis (15.6 months after initial UM diagnosis). The second patient underwent enucleation and was metastasis-free 30 months after treatment for the recurrence.



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.<sup>1</sup>

## 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.



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

Photo courtesy of Teresa Chen, MD

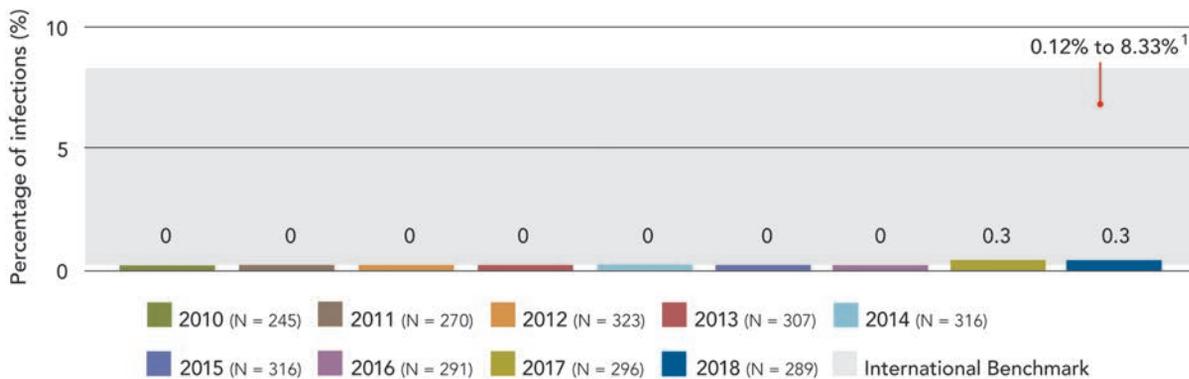
### Trabeculectomy and Tube Shunt Infection Rates

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 2018 calendar year, the Glaucoma Consultation Service performed a total of 289 trabeculectomy and tube shunt surgeries on adults. These surgeries included trabeculectomy (with or without previous scarring) on 89 eyes, and tube shunt surgeries (primary or revision) on 200 eyes. Of these, 82 cases were combined with other procedures, such as cataract extraction or keratoprosthesis surgery. Of note, nine pediatric cases performed by specialized faculty within the Glaucoma Consultation 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.<sup>1</sup>

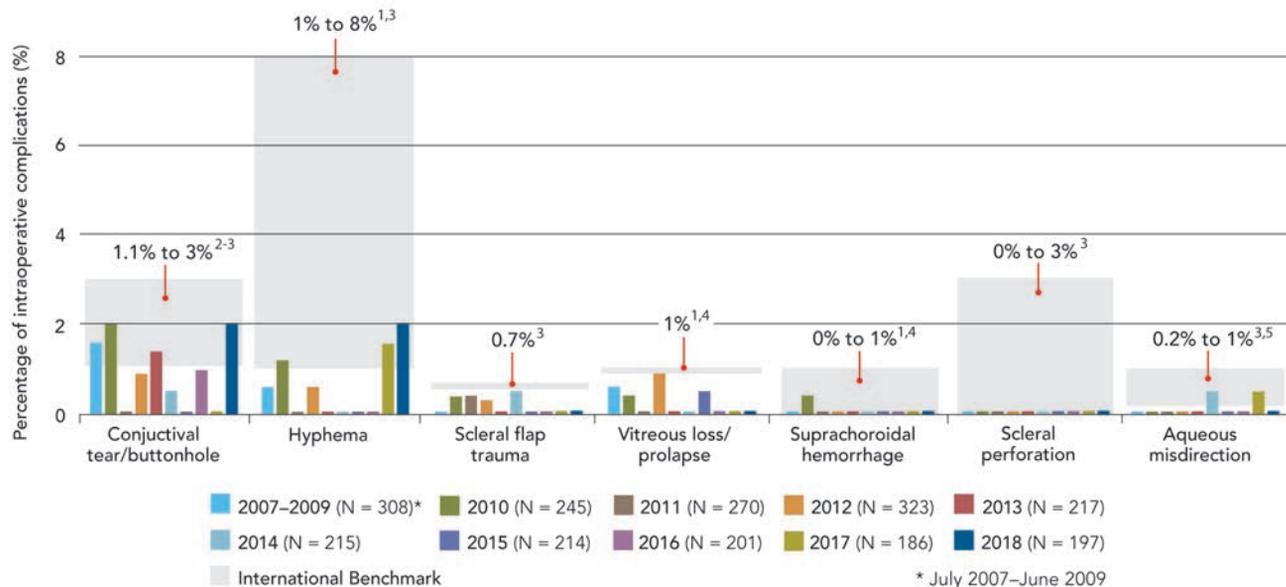
During calendar year 2018, there was one reported case of post-surgical endophthalmitis within 30 days of surgery in the Glaucoma Consultation Service, leading to an infection rate of 0.3%. The patient presented with bleb-associated infectious scleritis with endophthalmitis and keratitis 10 days after trabeculectomy with Ex-PRESS shunt complicated by intraoperative flap dehiscence. On presentation, the patient had a visual acuity of hand motion. The patient was admitted for intravenous broad spectrum antibiotics and co-managed by Infectious Disease, Cornea, and Retina services. A vitreous tap, conjunctival culture, and intravitreal injection of ceftazidime and vancomycin were performed on the same day. The next day a subconjunctival injection of ceftazidime was administered. Five days later a second vitreous tap and intravitreal injection of ceftazidime and vancomycin was performed due to worsening hypopyon. Three days later a second subconjunctival injection of vancomycin was administered. Conjunctival culture showed few *Streptococcus pneumoniae*. There was no growth in vitreous cultures. At six months post-treatment, the patient's best corrected visual acuity was hand motion, compared to a baseline vision of 20/70, in the setting of corneal scarring and neovascularization.



Reference: <sup>1</sup>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 2018 calendar year, 289 trabeculectomy surgeries and glaucoma tube shunt surgeries were performed by the Glaucoma Consultation Service. Eighty-two cases that were combined with other procedures (i.e. cataract surgery, secondary lens implantation, or keratoprosthesis surgery), as well as an additional 10 Ex-PRESS shunt cases were excluded, which left 197 cases for analysis. Of these, 95.9% (189/197) of patients had no intraoperative complications. For trabeculectomy and glaucoma tube shunt surgery, similar results were reported from calendar year 2010 to 2017.



Minimally invasive glaucoma surgery (MIGS) represents a fast-growing field within the subspecialty of glaucoma and refers to surgical interventions, often entailing the implantation of new devices, for patients with uncontrolled eye pressure. MIGS has become a rapidly adopted alternative to existing, more invasive, glaucoma surgeries such as trabeculectomy and tube shunt surgery. Due to the fast-paced growth of the field, long-term data regarding safety and outcomes are limited. To address this, Mass. Eye and Ear has created a data repository program to track outcomes of all patients undergoing MIGS procedures, ensuring that patients receive cutting-edge treatments that are also safe and effective.

### Mass. Eye and Ear 2018 complication rates:

Conjunctival tear/buttonhole: **2.0%**  
 Hyphema: **2.0%**  
 Scleral flap trauma: **0%**  
 Vitreous loss (vitreal prolapse): **0%**  
 Suprachoroidal hemorrhage: **0%**  
 Scleral perforation: **0%**  
 Aqueous misdirection: **0%**

### The 197 cases evaluated included:

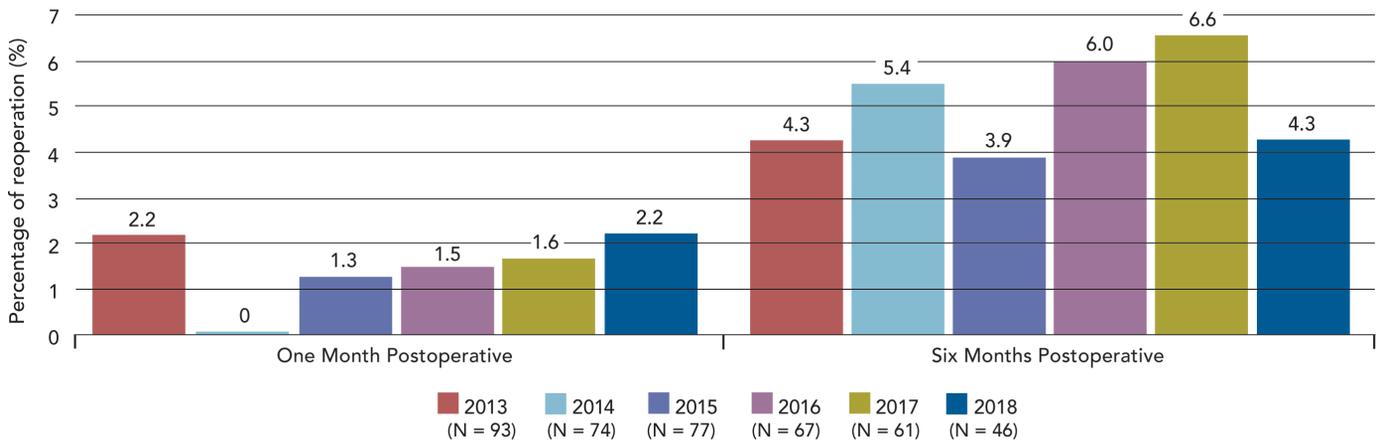
**40** trabeculectomies without scarring  
**6** trabeculectomies with previous scarring  
**125** primary tube surgeries  
**26** tube revisions

References: <sup>1</sup>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. <sup>2</sup>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. <sup>3</sup>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. <sup>4</sup>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. <sup>5</sup>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

The majority of trabeculectomies at Mass. Eye and Ear are performed with mitomycin C for prevention of scar formation at the surgical flap. In this analysis, mitomycin C trabeculectomies that were combined with other procedures, such as cataract surgery, secondary lens implantation, keratoprosthesis procedures, and Ex-PRESS implantations, were excluded. From a total of 89 trabeculectomy surgeries performed in calendar year 2018, this left 46 mitomycin C trabeculectomies (with or without previous scarring) for analysis performed by the Glaucoma Consultation Service 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).

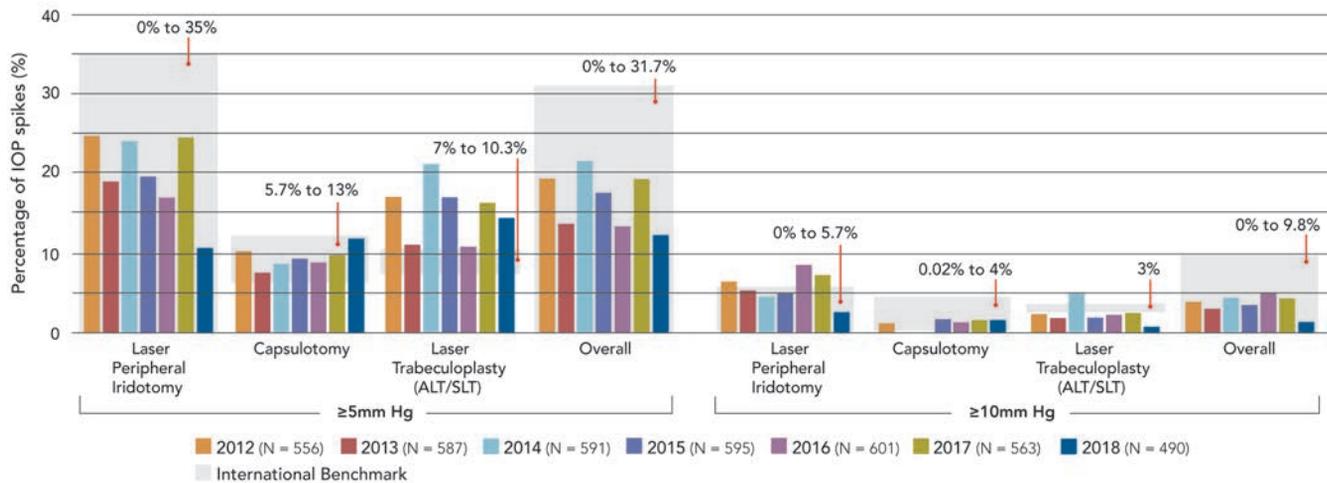
The reoperation rate for mitomycin C trabeculectomy surgery was 2.2% within one month (one repeat trabeculectomy in 46 patients) and 4.3% within six months (two repeat trabeculectomies in 46 patients) after surgery. Published data on one- and six-month reoperation rates are lacking; therefore, our reported 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

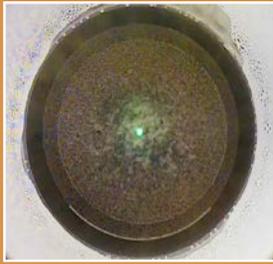
During calendar year 2018, the Glaucoma Consultation Service performed anterior segment laser procedures, including peripheral iridotomies, capsulotomies, and laser trabeculoplasties, on 519 eyes. Two eyes of one patient were excluded due to performance of the procedure under general anesthesia. Of the remaining eyes, 490 had complete information for analysis, numbering 221 laser peripheral iridotomies, 60 capsulotomies, and 209 laser trabeculoplasties. Of the 209 laser trabeculoplasties, 20 were argon laser trabeculoplasties (ALT) and 189 were selective laser trabeculoplasties (SLT). Medical charts were reviewed to determine the number of patients who developed an intraocular pressure (IOP) spike of either  $\geq 5$  mm Hg or  $\geq 10$  mm Hg immediately after the laser procedure.



	$\geq 5$ mm Hg		$\geq 10$ mm Hg	
	Mass. Eye and Ear	International <sup>1-8</sup>	Mass. Eye and Ear	International <sup>1, 3-4, 6-10</sup>
Laser peripheral iridotomy:	10.9%	0% to 35%	1.4%	0% to 5.7%
Capsulotomy:	11.7%	5.7% to 13%	1.7%	0.02% to 4%
Laser trabeculoplasty:	14.4%	7% to 10.3%	0.5%	3%
Overall:	12.4%	0% to 31.7%	1.0%	0% to 9.8%

References: <sup>1</sup>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. <sup>2</sup>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. <sup>3</sup>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. *J Ocul Pharmacol Ther* 2006; 22(3): 176-181. <sup>4</sup>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. <sup>5</sup>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. <sup>6</sup>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. <sup>7</sup>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. <sup>8</sup>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. <sup>9</sup>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. <sup>10</sup>Jiang Y, Chang DS, Foster PJ, et al. Immediate changes in intraocular pressure after laser peripheral iridotomy in primary angle-closure suspects. *Ophthalmology* 2012; 119 (2): 283-288.

## 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.

*Gas pattern after completion of the laser passes of SMILE.*

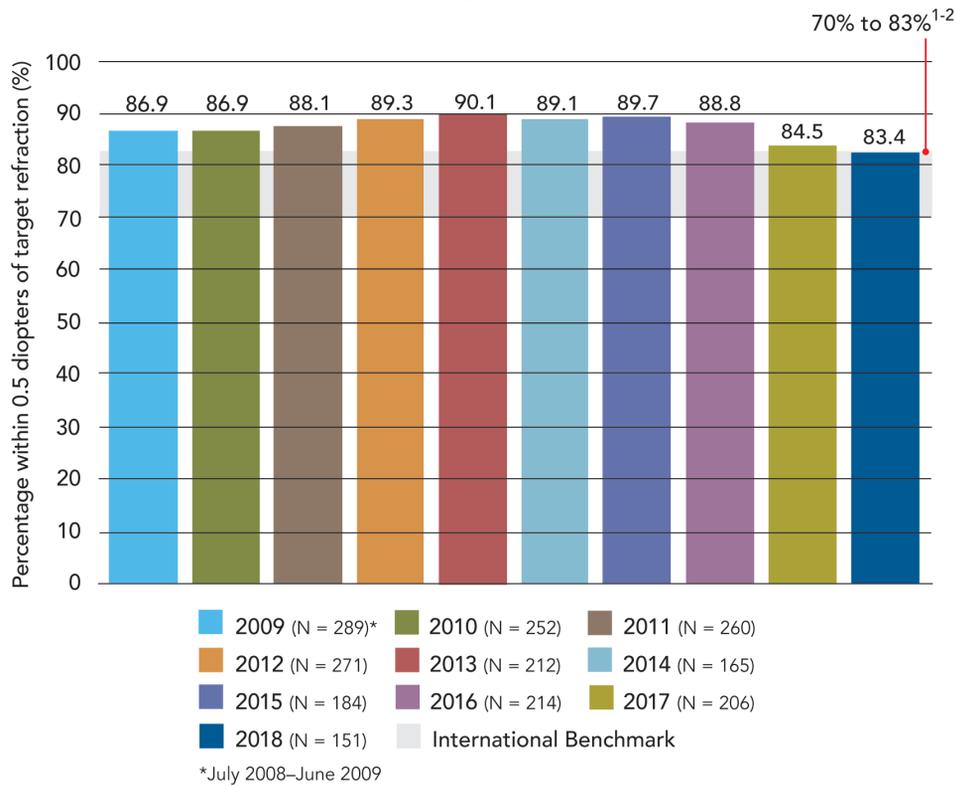
*Photo courtesy of Kathryn M. Hatch, MD*

### LASIK for Myopia and Myopic Astigmatism: Achieving Target Refraction (Spherical Equivalent)

During the 2018 calendar year, 239 eyes had LASIK surgery for myopia. Of the 151 eyes that had follow-up data available between one and three months postoperatively, 83.4% (126/151 eyes) achieved within 0.5 diopter of target refraction. Patients with astigmatism (ranging from -0.25 to -3.75 diopters) were included in the analysis.

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.<sup>1</sup> 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.<sup>1-2</sup>

For the past 10 years, the Mass. Eye and Ear Cornea and Refractive Surgery Service has consistently exceeded international benchmarks for successful LASIK surgery for myopia.

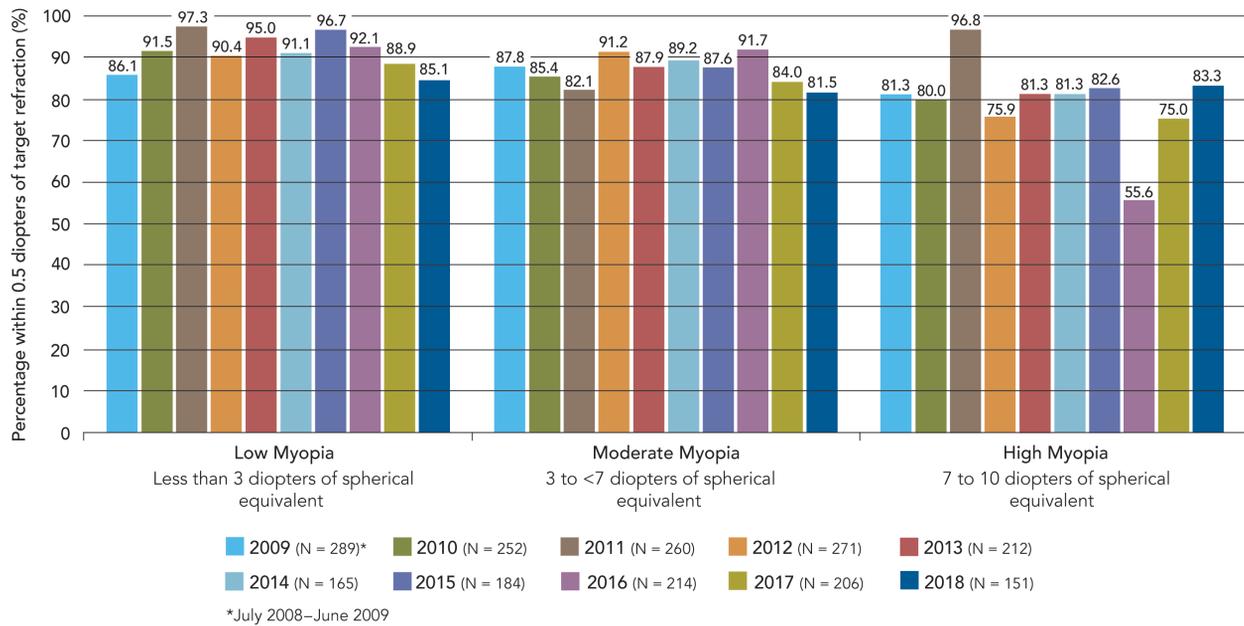


The overall LASIK success rate for achieving within 0.5 diopters of target refraction for myopia and hyperopia combined in 2018 was 82.2% (139/169 eyes).

References: <sup>1</sup>Bailey MD, Zadnick K. Outcomes of LASIK for myopia with FDA-approved lasers. *Cornea* 2007; 26(3), 246–254. <sup>2</sup>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.

## LASIK for Different Degrees of Myopia and Myopic Astigmatism: Achieving Target Refraction (Spherical Equivalent)

In calendar year 2018, 239 eyes had LASIK surgery for myopia. Of these, 151 eyes had between one and three months follow-up data available for analysis. The success rates based on the degree of myopia are illustrated here. LASIK for low myopia was performed on 74 eyes, and of these, 85.1% (63/74 eyes) were successful (achieved within 0.5 diopters of target refraction at their follow-up). For the 65 eyes with moderate myopia, 81.5% (53/65 eyes) were successful; and for the 12 eyes with high myopia, 83.3% (10/12 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 2017.

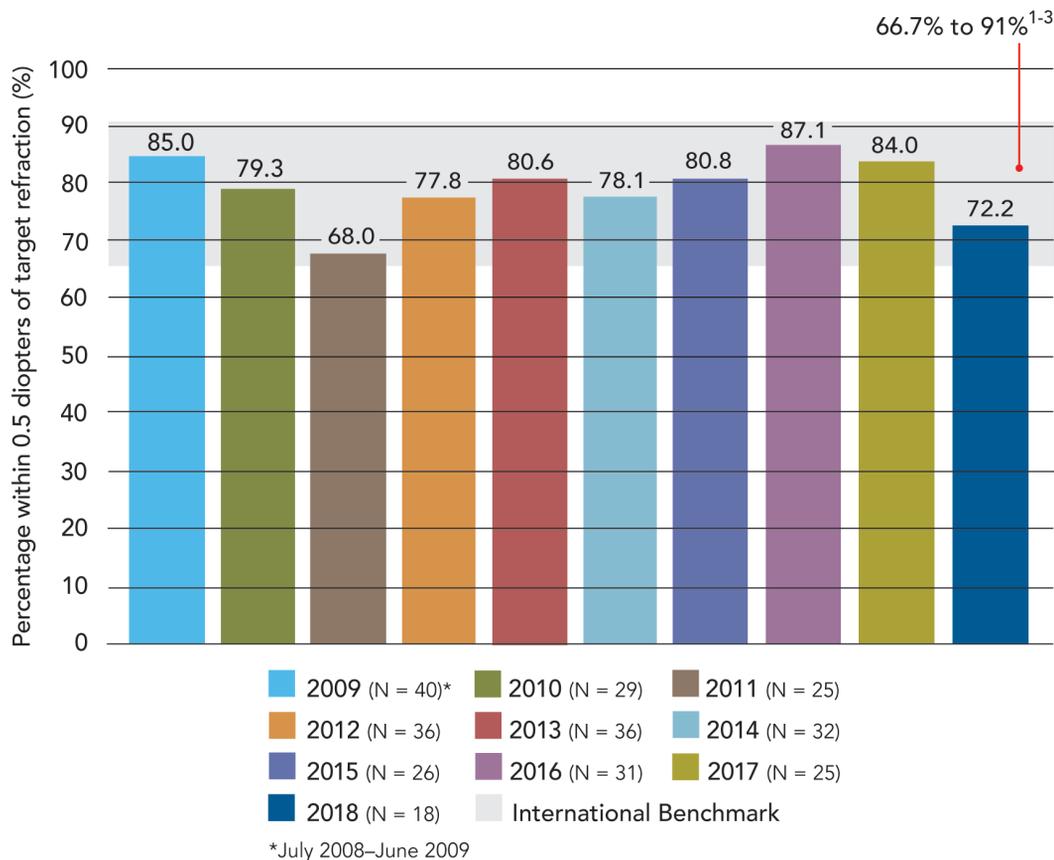


The Mass. Eye and Ear Cornea and Refractive Surgery Service continues to maintain a high overall success rate for LASIK surgery for myopia.

## LASIK for Hyperopia and Hyperopic Astigmatism: Achieving Target Refraction (Spherical Equivalent)

Of the 41 eyes that had LASIK surgery for hyperopia during the 2018 calendar year, 18 had between three and six months of follow-up data available for analysis. The overall 2018 LASIK success rate for achieving within 0.5 diopters of target refraction was 72.2% (13/18 eyes) for hyperopia. Patients with astigmatism (ranging from -0.25 to -2.5 diopters) were included in the analysis.

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%.<sup>1-3</sup>



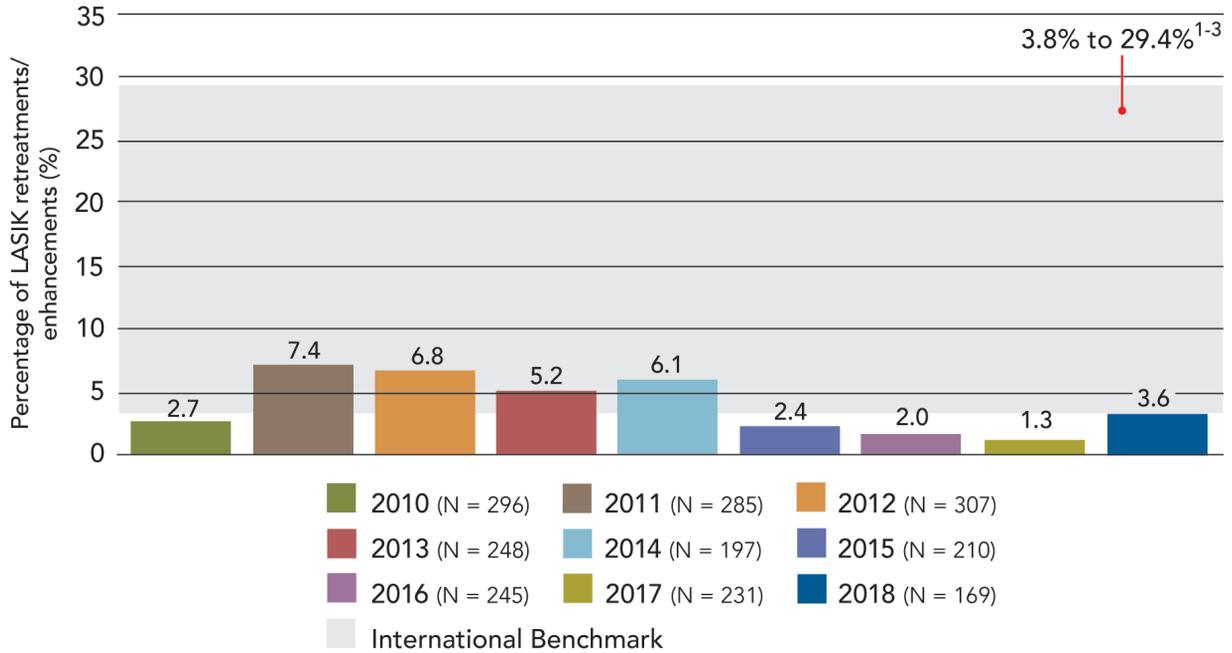
For the past 10 years, the Mass. Eye and Ear Cornea and Refractive Surgery Service has consistently met the international benchmarks for successful LASIK surgery for hyperopia.

References: <sup>1</sup>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. <sup>2</sup>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. <sup>3</sup>Cole Eye Institute. Outcomes 2012.

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

During the 2018 calendar year, 169 of the 280 eyes that had LASIK surgery had sufficient follow-up data for analysis. Sufficient follow-up was defined as data available between one and three months for myopia and between three and six months for hyperopia. Of these 169 eyes, 3.6% (6/169) had an enhancement/retreatment procedure within six months of surgery. Similar results have been reported since calendar year 2010 when data collection for enhancement/retreatment rates began.

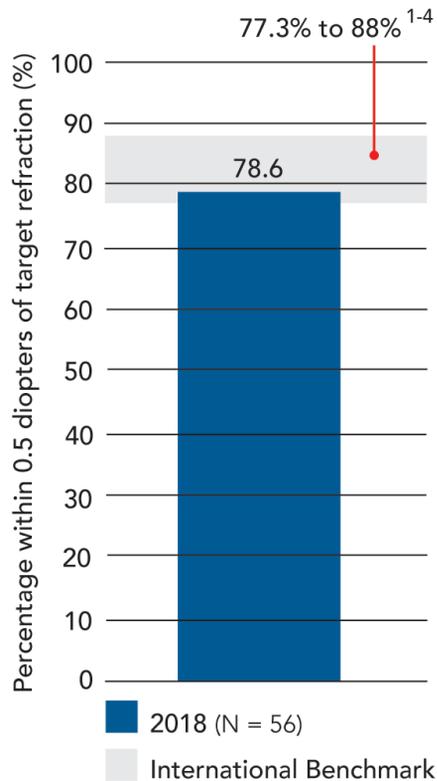
LASIK retreatment rates of between 3.8% and 29.4% have been reported in the literature.<sup>1-3</sup>



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

## SMILE for Myopia and Myopic Astigmatism: Achieving Target Refraction (Spherical Equivalent)

During the 2018 calendar year, 71 eyes had small incision lenticule extraction (SMILE) surgery for myopia. Of the 56 eyes that had between one and three months of follow-up data available for analysis, 78.6% (44/56 eyes) achieved within 0.5 diopter of target refraction. Patients with astigmatism (ranging from -0.25 to -2.75 diopters) were included in the analysis.



Small incision lenticule extraction (SMILE) is an FDA-approved procedure for the treatment of spherical myopia and myopic astigmatism. SMILE uses the latest laser technology to gently create a thin, contact lens-shaped layer just beneath the surface of the eye. This lenticule is then removed through a tiny opening. The adoption of SMILE is growing as a minimally invasive technology that allows for a rapid visual recovery, reduced risk of dry eye, and no postoperative restrictions.

References: <sup>1</sup>Sekundo W, Kunert KS, Blum M. Small incision corneal refractive surgery using the small incision lenticule extraction (SMILE) procedure for the correction of myopia and myopic astigmatism: results of a 6 months prospective study. *Br J Ophthalmol* 2011; 95(3): 335-339. <sup>2</sup>Vestergaard AH, Grauslund J, Ivarsen AR, et al. Efficacy, safety, predictability, contrast sensitivity, and aberrations after femtosecond laser lenticule extraction. *J Cataract Refract Surg* 2014; 40(3): 403-11. <sup>3</sup>Kanellopoulos AJ. Topography-guided LASIK versus small incision lenticule extraction (SMILE) for myopia and myopic astigmatism: a randomized, prospective, contralateral eye study. *J Refract Surg* 2017; 33(5): 306-312. <sup>4</sup>Kamiya K, Takahashi M, Nakamura T, et al. A multicenter study on early outcomes of small-incision lenticule extraction for myopia. *Sci Re* 2019; 9(1): 4067.

## Cornea Surgery



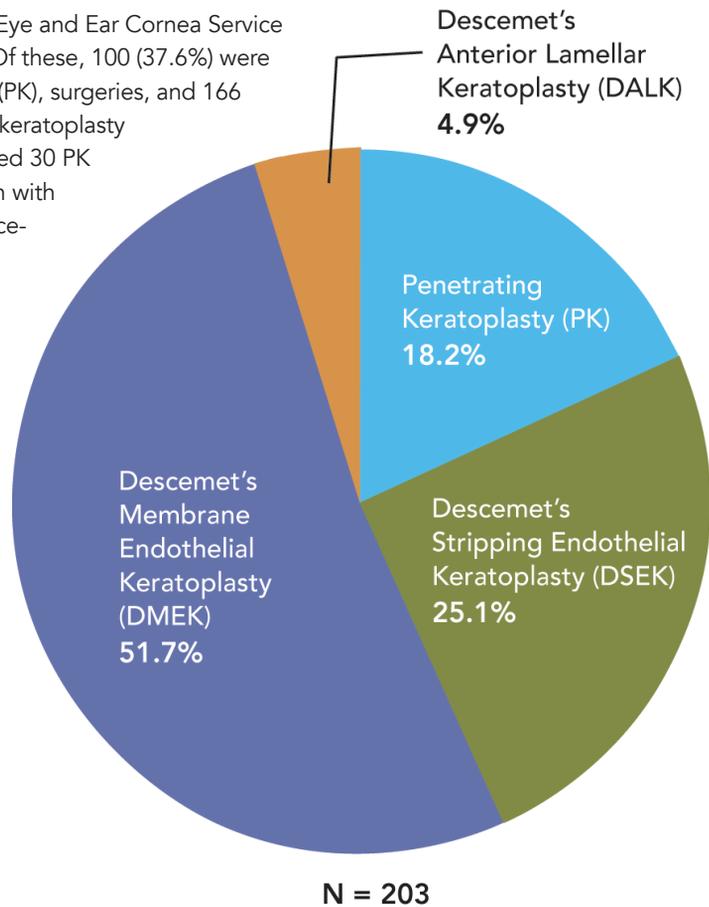
The Mass. Eye and Ear Cornea Service is highly skilled at correcting a variety of corneal disorders that disrupt vision. When appropriate, our clinicians perform more advanced lamellar procedures over penetrating keratoplasties in order to limit scarring and improve graft results.

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

*Photo courtesy of Ula V. Jurkunas, MD*

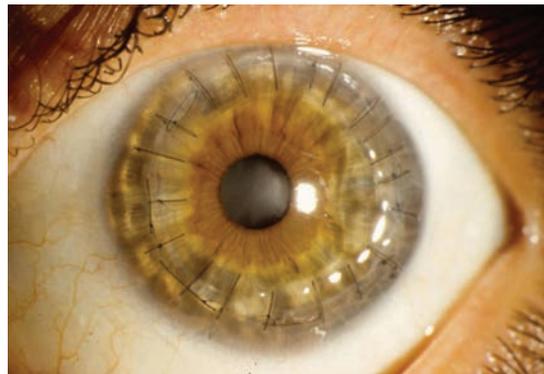
### Distribution of Full-Thickness and Partial-Thickness Keratoplasty

During the 2018 calendar year, the Mass. Eye and Ear Cornea Service performed 266 keratoplasty procedures. Of these, 100 (37.6%) were full-thickness, or penetrating keratoplasty (PK), surgeries, and 166 (62.4%) were partial-thickness, or lamellar keratoplasty surgeries. This distribution analysis excluded 30 PK procedures that were done in combination with retinal, glaucoma, or keratoprosthesis procedures, as well as 33 therapeutic PK procedures done for active corneal infections or non-healing ulcers. This left 37 PKs for inclusion in the distribution analysis compared to 166 partial-thickness transplants. The subdivision of lamellar keratoplasty procedures was 51 Descemet's stripping endothelial keratoplasties (DSEKs), 105 Descemet's membrane endothelial keratoplasties (DMEKs), and 10 deep anterior lamellar keratoplasties (DALKs).



The Mass. Eye and Ear Cornea Service has faculty who specialize in pediatric keratoplasty cases. In calendar year 2018, the service performed seven pediatric keratoplasty procedures, which have not been included in the analysis.

## Penetrating Keratoplasty



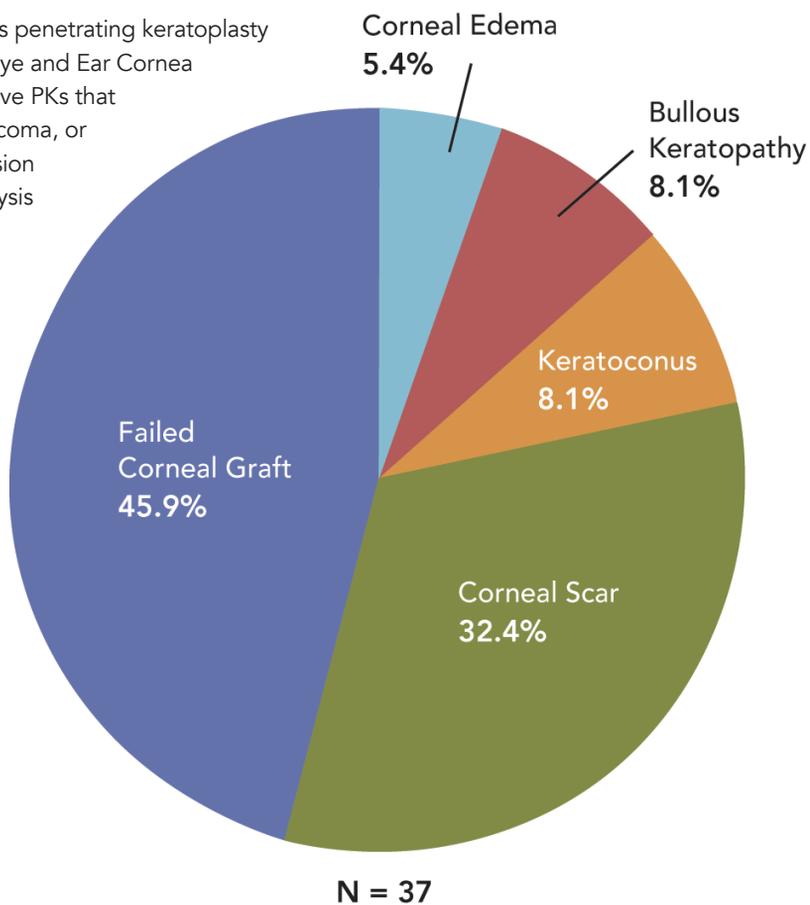
Preoperative and postoperative right eye that underwent penetrating keratoplasty (PK) for pseudomonas keratitis in a prior radial keratotomy incision.

Photos courtesy of James Chodosh, MD, MPH

## Surgical Indications for Penetrating Keratoplasty

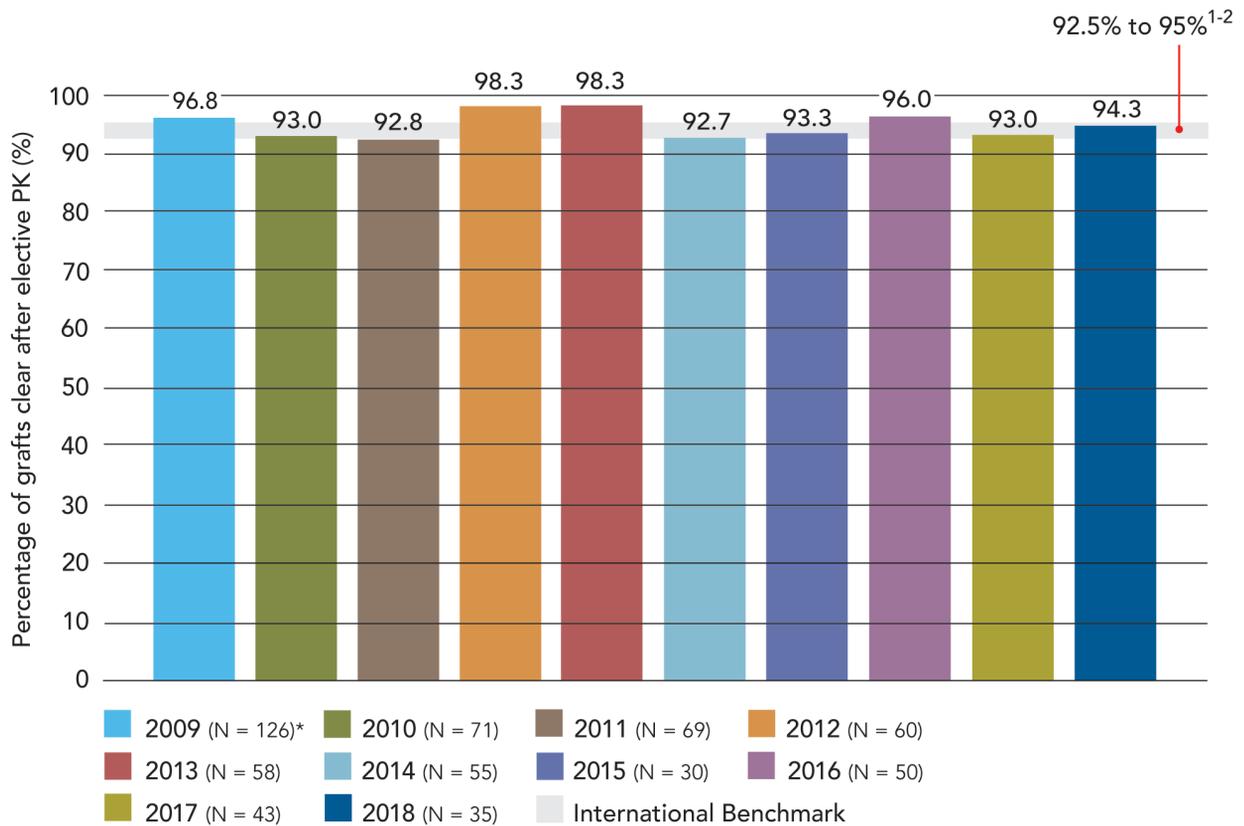
During the 2018 calendar year, 100 full-thickness penetrating keratoplasty (PK) procedures were performed by the Mass. Eye and Ear Cornea Service. The current analysis includes only elective PKs that were not done in combination with retinal, glaucoma, or keratoprosthesis procedures. Using these exclusion criteria, 37 (37%) elective PKs remained for analysis for calendar year 2018. These 37 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 (17/37, 45.9%), corneal scar (12/37, 32.4%), keratoconus (3/37, 8.1%), bullous keratopathy (3/37, 8.1%), and corneal edema (2/37, 5.4%).



## Clear Corneal Grafts After Penetrating Keratoplasty Surgery

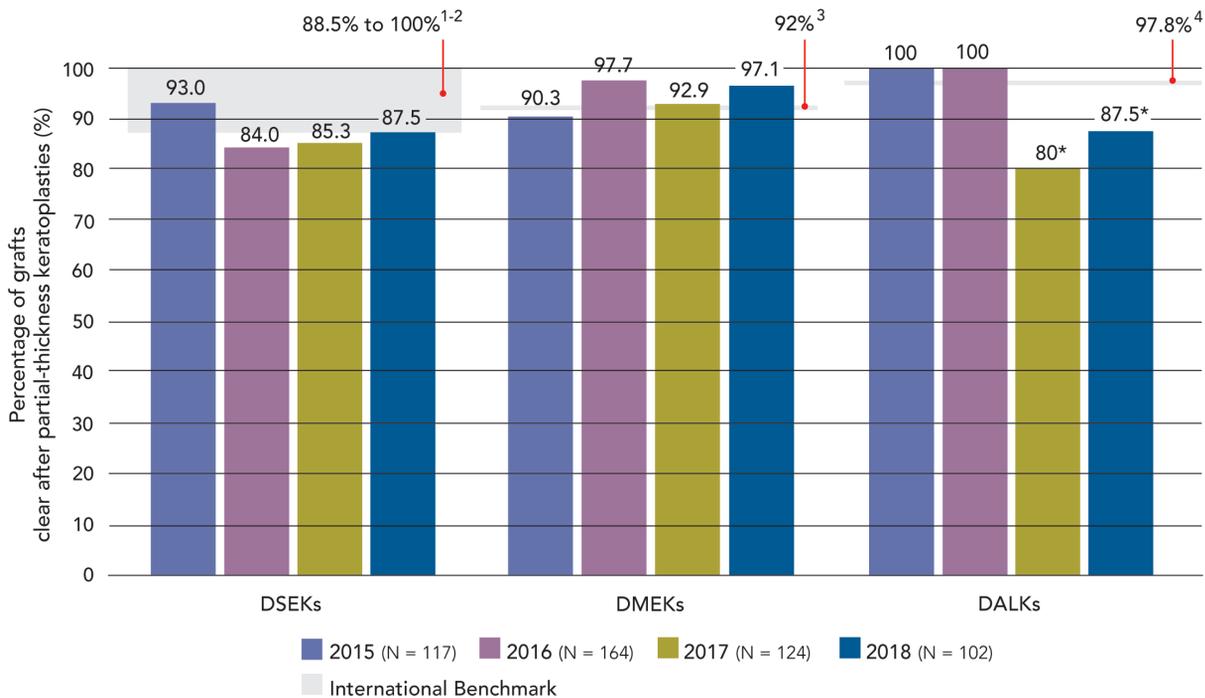
Of the 35 elective penetrating keratoplasty (PK) surgeries with sufficient follow-up for analysis, 33 (94.3%) achieved surgical success, which is defined as a graft at three to five months follow-up with minimal to no clinical edema and with sufficient clarity to permit the examiner to have an unencumbered view of the interior of the eye, including iris details.



**Mass. Eye and Ear PK surgery success rates are comparable to international benchmarks.<sup>1-2</sup>**

## Clear Corneal Grafts After Partial-Thickness Keratoplasty Surgery

Of 166 partial-thickness keratoplasties performed in calendar year 2018 by the Mass. Eye and Ear Cornea Service, 102 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 102 procedures included 24 Descemet's stripping endothelial keratoplasties (DSEKs), 70 Descemet's membrane endothelial keratoplasties (DMEKs), and eight deep anterior lamellar keratoplasties (DALKs). Of these 102 procedures, 96 (94.1%) achieved surgical success, which is defined as a graft at three to five 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.



\*Note the small sample size of only 8 DALKs in 2018. With a significance level of  $p$  value = 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), or 2016 and 2018 ( $p$  value = 0.35).

References: <sup>1</sup>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. <sup>2</sup>Koenig SB, Covert DJ. Early results of small-Incision Descemet's stripping and automated endothelial keratoplasty. *Ophthalmology* 2007; 114(2): 221-226. <sup>3</sup>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. <sup>4</sup>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.

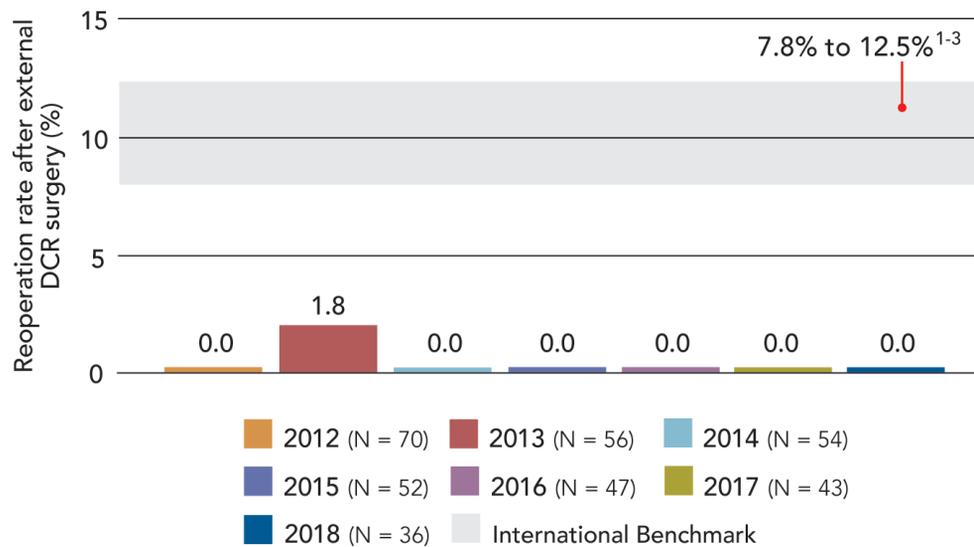
## Oculoplastic Surgery

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.

### Oculoplastic Surgery: Reoperation Rate for Primary External Dacryocystorhinostomy Surgery at Six Months Follow-up

During the 2018 calendar year, the Mass. Eye and Ear Ophthalmic Plastic Surgery Service performed external dacryocystorhinostomy (Ex-DCR) procedures on 49 eyes of 41 patients. Five eyes of five patients were excluded for pre-existing ocular conditions (sarcoidosis, benign tumor, 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 six patients were excluded because of a history of prior lacrimal surgery. This analysis includes the remaining 36 eyes of 30 patients who underwent primary Ex-DCR in 2018 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, 2016, and 2017, during which time there were no reoperations within six months of primary Ex-DCR.

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



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

## Reoperation Rate for Primary Endoscopic Dacryocystorhinostomy Surgery at Six Months Follow-up

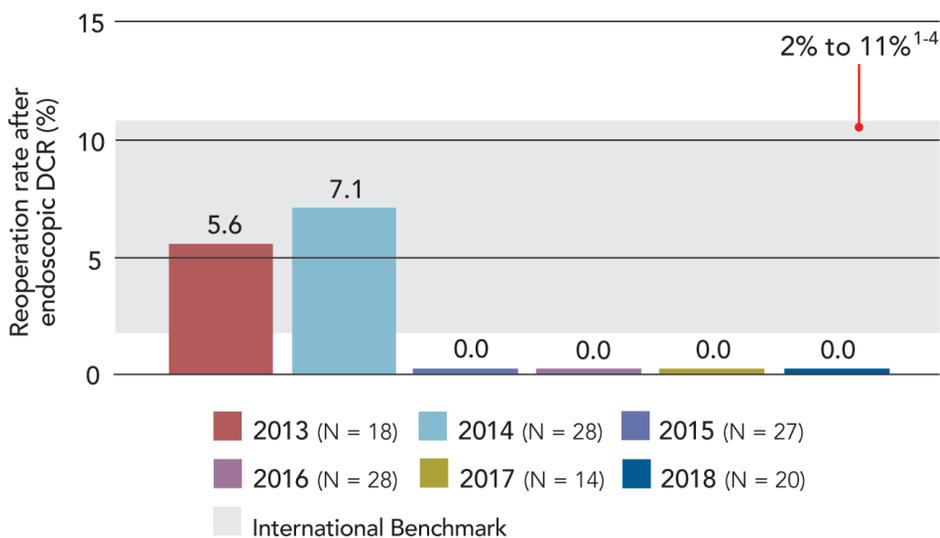


Intraoperative endoscopic view of En-DCR ostium with silicone stent in position.

Photo courtesy of Daniel R. Lefebvre, MD, FACS

During the 2018 calendar year, the Mass. Eye and Ear Ophthalmic Plastic Surgery Service performed endoscopic dacryocystorhinostomy (En-DCR) procedures on 45 eyes of 36 patients. Nine eyes of six 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. Sixteen eyes of 12 patients also were excluded because of a history of prior lacrimal surgery. This analysis includes the remaining 20 eyes of 18 patients who underwent primary En-DCR in 2018 for primary acquired nasolacrimal duct obstruction (NLDO). None of these 20 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.<sup>1-4</sup>



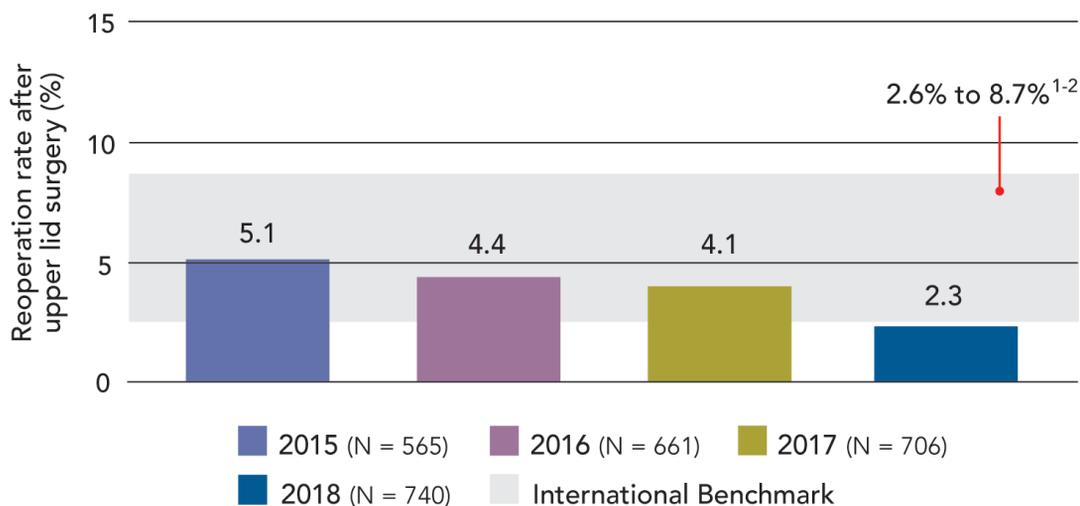
In contrast to conventional external DCR (Ex-DCR), En-DCR is a minimally invasive procedure that is possible due to technological advances in instruments used in rhinologic surgery. This analysis includes En-DCR procedures done in patients with underlying sinus disease or other intranasal abnormality such as significant septal deviation. Of the 45 eyes, 29 eyes of 23 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: <sup>1</sup>Dolman PJ. Comparison of external dacryocystorhinostomy with nonlaser endonasal dacryocystorhinostomy. *Ophthalmology* 2003; 110(1): 78-84. <sup>2</sup>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. <sup>3</sup>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. <sup>4</sup>Codère F, Denton P, Corona J. Endonasal dacryocystorhinostomy: a modified technique with preservation of the nasal and lacrimal mucosa. *Ophthalm Plast Reconstr Surg* 2010; 26(3): 161-164.

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

During the 2018 calendar year, the Mass. Eye and Ear Ophthalmic Plastic Surgery Service performed upper blepharoplasty and/or ptosis repair surgeries on 827 eyelids in 471 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 827 lid surgeries, 87 were excluded because of a history of prior upper lid surgery, such as tumor removal, orbital decompression, blepharoplasty, and ptosis repair. This left 740 lid surgeries for the following analysis. Of these 740 lid surgeries, only 2.3% (17/740) 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%.<sup>1-2</sup>



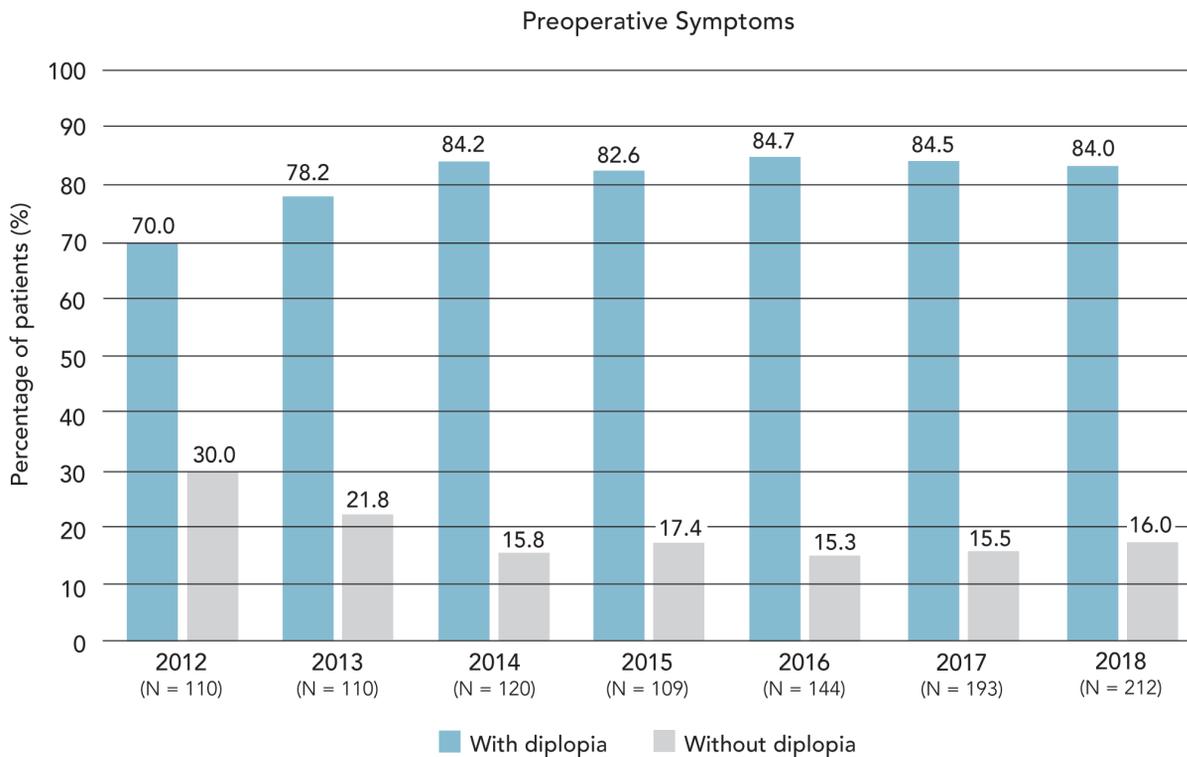
The Mass. Eye and Ear Ophthalmic Plastic Surgery Service has maintained a low reoperation rate for upper eyelid surgeries compared to international benchmarks.

## Adult Strabismus Service

The Adult Strabismus 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 and is distinct from the Mass. Eye and Ear Pediatric Ophthalmology and Strabismus Service, which is affiliated with Boston Children's Hospital.

### Preoperative Symptoms in Adult Strabismus Surgery Patients

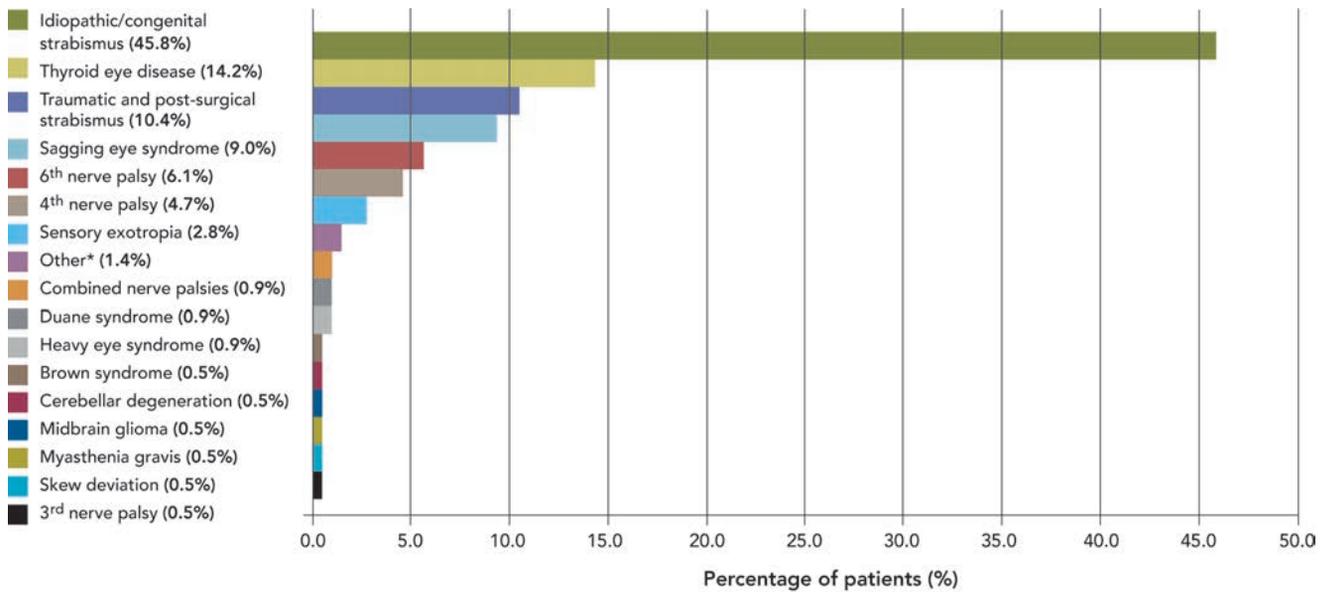
During the 2018 calendar year, the Mass. Eye and Ear Adult Strabismus Service performed strabismus surgery on 212 patients. The majority of patients (84.0% or 178 patients) had diplopia preoperatively, while 16.0% or 34 patients did not have diplopia. Diplopia was also a common preoperative symptom in prior calendar years, as shown below.



Diplopia is one of the most common indications for surgical intervention at the Mass. Eye and Ear Adult Strabismus Service.

## Underlying Etiologies Associated with Adult Strabismus Surgery

Of the 212 strabismus surgery cases performed in calendar year 2018, the most common etiology was idiopathic or congenital strabismus (45.8% or 97 patients). Thyroid eye disease was the second most common cause (14.2% or 30 patients). Other etiologies included traumatic and post-surgical strabismus (10.4% or 22 patients), sagging eye syndrome (9.0% or 19 patients), 6<sup>th</sup> nerve palsy (6.1% or 13 patients), 4<sup>th</sup> nerve palsy (4.7% or 10 patients), sensory exotropia (2.8% or 6 patients), other (1.4% or 3 patients), heavy eye syndrome (0.9% or 2 patients), Duane syndrome (0.9% or 2 patients), and combined nerve palsies (0.9% or 2 patients). There was one patient treated with each of the following diagnoses: skew deviation, Myasthenia gravis, midbrain glioma, cerebellar degeneration, Brown syndrome, and 3<sup>rd</sup> nerve palsy.



\* Includes midbrain stroke, top of basilar stroke, and multiple sclerosis

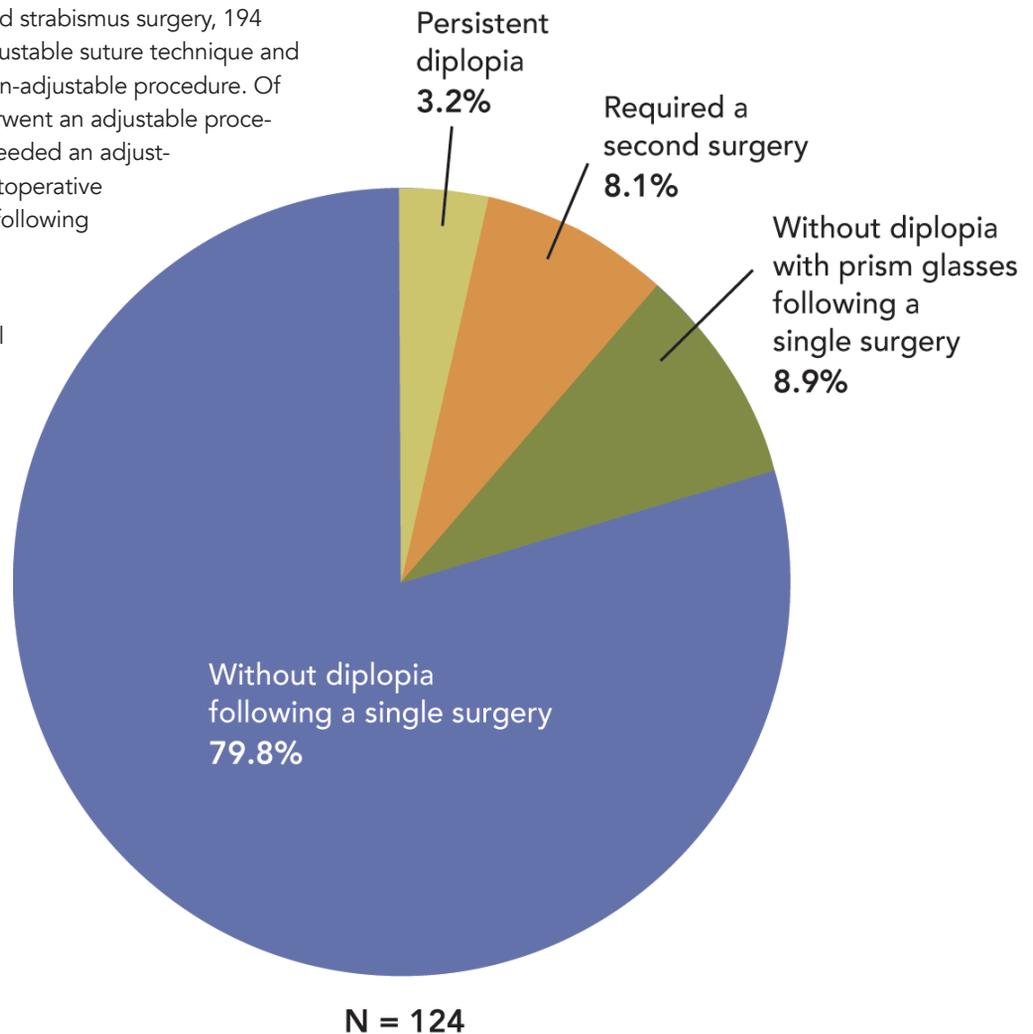
The most common indications for adult strabismus surgery in the Adult Strabismus Service were idiopathic/congenital strabismus, 4<sup>th</sup> nerve palsy, thyroid eye disease, and sagging eye syndrome.

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

In calendar year 2018, 178 of 212 patients (84.0%) had diplopia prior to their surgery. Of these 178 patients, 124 had between one and six months follow-up data available and therefore were included in the following analysis. Postoperatively, 99 of 124 patients (79.8%) 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. Eleven of 124 patients (8.9%) who had diplopia after surgery were without diplopia in primary position with prism glasses. Ten of 124 patients (8.1%) required a second surgery that was either performed within six months (four patients) or scheduled by the time of their six month follow-up visit (six patients). The remaining four of 124 patients (3.2%) had persistent diplopia at their follow-up appointment closest to six months. Of note, the goal for two of these four patients was not to eliminate diplopia in a single surgery.

Of the 212 patients who had strabismus surgery, 194 patients (91.5%) had an adjustable suture technique and 18 patients (8.5%) had a non-adjustable procedure. Of the 194 patients who underwent an adjustable procedure, 50 patients (25.8%) needed an adjustment in the immediate postoperative period (two to three 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 2017.



After strabismus surgery at the Mass. Eye and Ear Adult Strabismus Service, most patients (79.8%) were without diplopia in primary position.

## Neuro-Ophthalmology Service

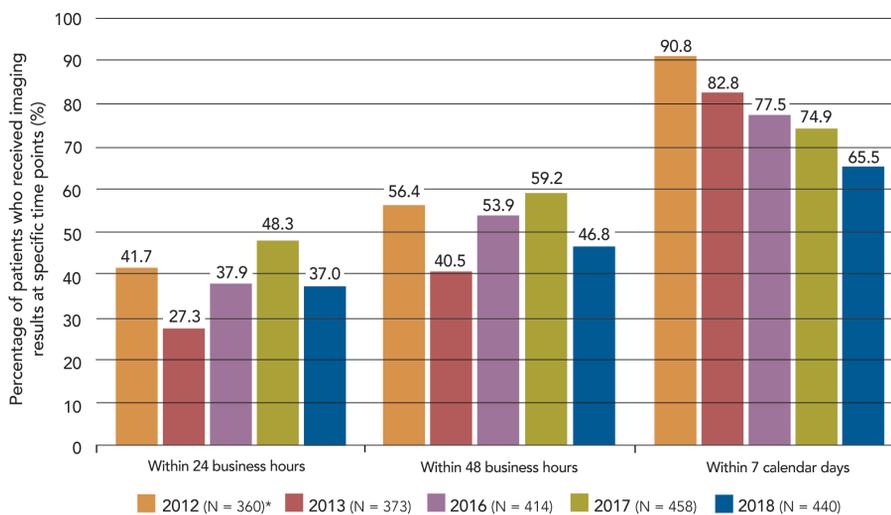
The Neuro-Ophthalmology Service at Mass. Eye and Ear diagnoses and treats a wide variety of disorders that affect the cranial nerves and orbit, many of which require advanced imaging.

### Providing Imaging Results to Patients

During calendar year 2018, the Mass. Eye and Ear Neuro-Ophthalmology Service ordered and performed 440 outpatient neuroimaging scans (MRI and CT scans). 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 440 imaging studies included in the 2018 analysis, scan follow-up rates were as follows: 163 scans (37.0%) were reviewed with the patient within one business day, 206 (46.8%) within two business days, 288 (65.5%) within seven calendar days, 329 (74.8%) within 14 calendar days, and 355 (80.7%) within one month.

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.<sup>1-3</sup>



Of the 440 scans that were ordered by a physician in the Neuro-Ophthalmology Service and also completed at Mass. Eye and Ear in 2018, 406 scans (92.3%) had documentation of when the patient was notified of the test results. Similar results were reported for calendar years 2012, 2013, 2016, and 2017 during which time 96.7% (348/360), 94.9% (354/373), 98.1% (406/414), and 92.8% (425/458) 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.<sup>4-5</sup>

\*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%).

**The Mass. Eye and Ear Neuro-Ophthalmology Service strives for favorable rates of follow-up for results of outpatient imaging studies. It is difficult to determine whether the decreased rate of results reporting to patients within seven calendar days over the past three 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.**

References: <sup>1</sup>Singh H, Vij MS. Eight recommendations for policies for communicating abnormal test results. *Jt Comm J Qual Saf* 2010; 36(5): 226-232. <sup>2</sup>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. <sup>3</sup>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. <sup>4</sup>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. <sup>5</sup>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.

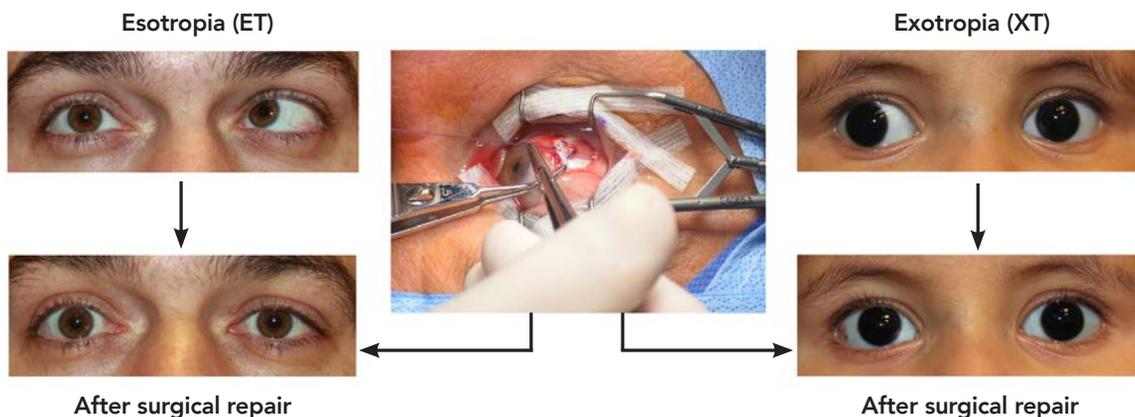
## Pediatric and Adult Strabismus Surgery With Children's Hospital Ophthalmology Foundation: Goal-Determined Outcomes

Ophthalmologists with joint appointments at Children's Hospital Ophthalmology Foundation and the Mass. 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 as well as adult strabismus surgery. This service is distinct from the Mass. Eye and Ear Adult Strabismus Service, for which results are presented on earlier pages.

Strabismus surgery is the most commonly performed ophthalmic procedure in children, and is also performed on adults with new or previously existing misalignment. Recession and resection procedures are often performed for horizontal misalignment; other approaches include tuck, loop myopexy, myectomy, tenotomy, and transposition.

Since the desired surgical outcome depends on the primary indication for surgery, the department designed a goal-determined methodology to assess surgical outcomes.<sup>1,2</sup> The analysis shown in the following pages 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 Children's Hospital Ophthalmology Foundation and the Mass. Eye and Ear Pediatric Ophthalmology and Strabismus Service. Procedures reported in the Adult Strabismus Service section are not included in this analysis.

### Pediatric and Adult Strabismus Surgery

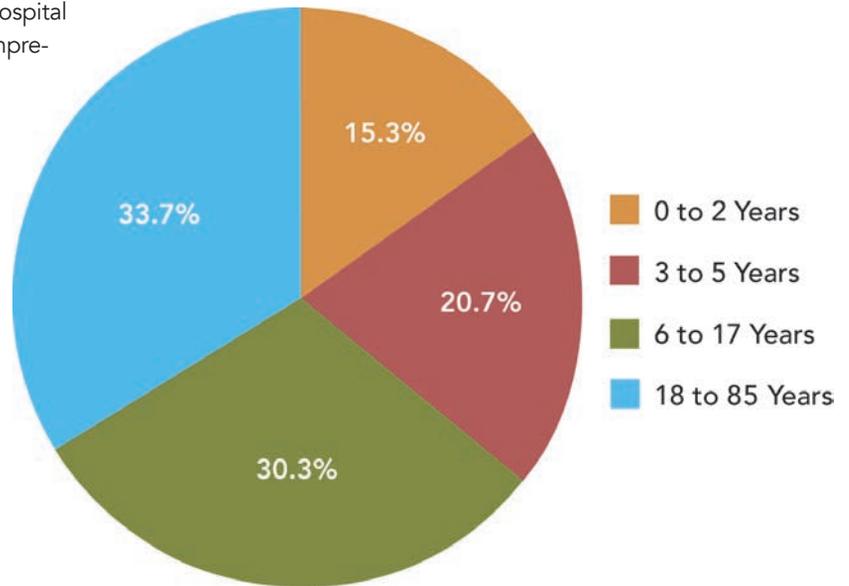


Preoperative and postoperative photos courtesy of Boston Children's Hospital, archive of ophthalmology department.  
Intraoperative photo courtesy of Garyfallia Pagonis.

References: <sup>1</sup>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. <sup>2</sup>Chang YH, Melvin P, Dagi LR. Goal-determined metrics to assess outcomes of exotropia surgery. *J AAPOS* 2015; 19: 304-310.

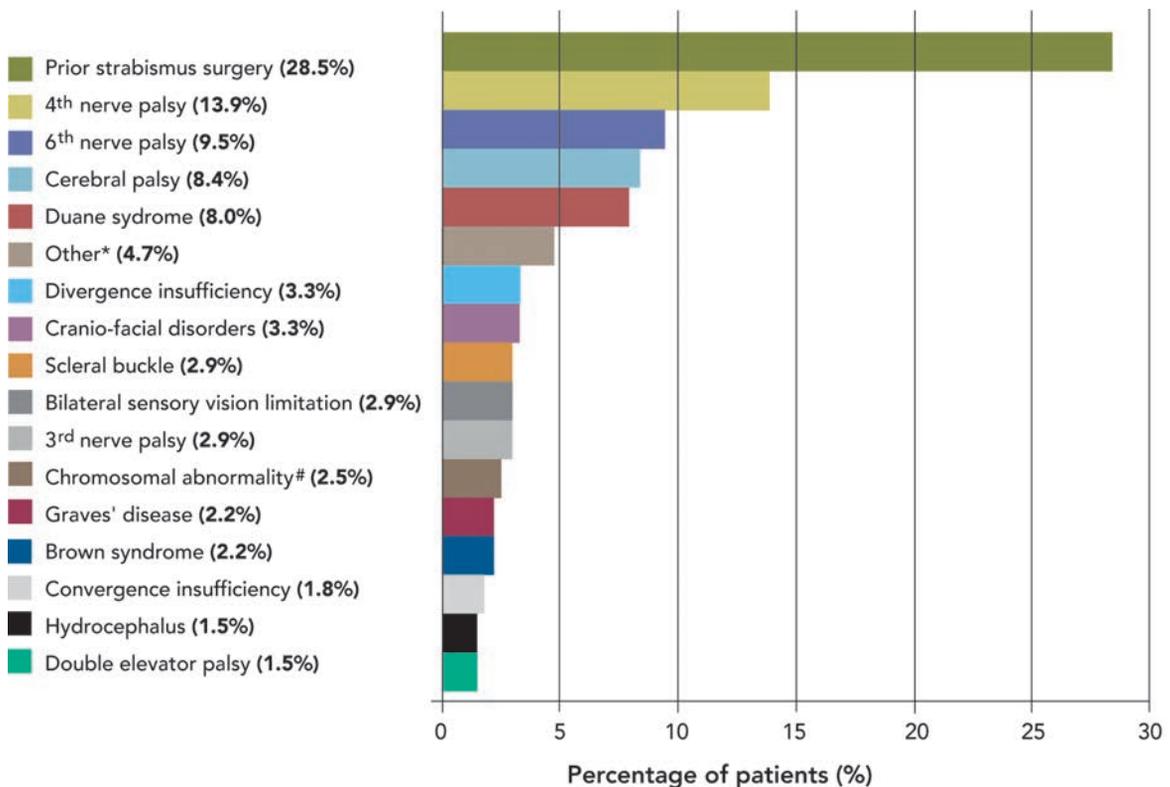
## Distribution of Strabismus Patients by Age

The Strabismus Service at Children's Hospital Ophthalmology Foundation offers comprehensive evaluation and treatment for children and adults with strabismus. A total of 603 strabismus surgeries were performed in 2018, with patients ranging from 4 months to 85 years of age.



## Distribution of Risk Factors in Strabismus Patients

Of the 603 strabismus surgeries performed in 2018, a total of 308 patients presented with associated risk factors. The most common risk factors were prior strabismus surgery (28.5%), 4<sup>th</sup> nerve palsy (13.9%), and 6<sup>th</sup> nerve palsy (9.5%).



\*Includes retinopathy of prematurity, optic nerve neuropathy, glaucoma, and aphakia.

#Includes Down syndrome, chromosomal deletion, and Angelman syndrome.

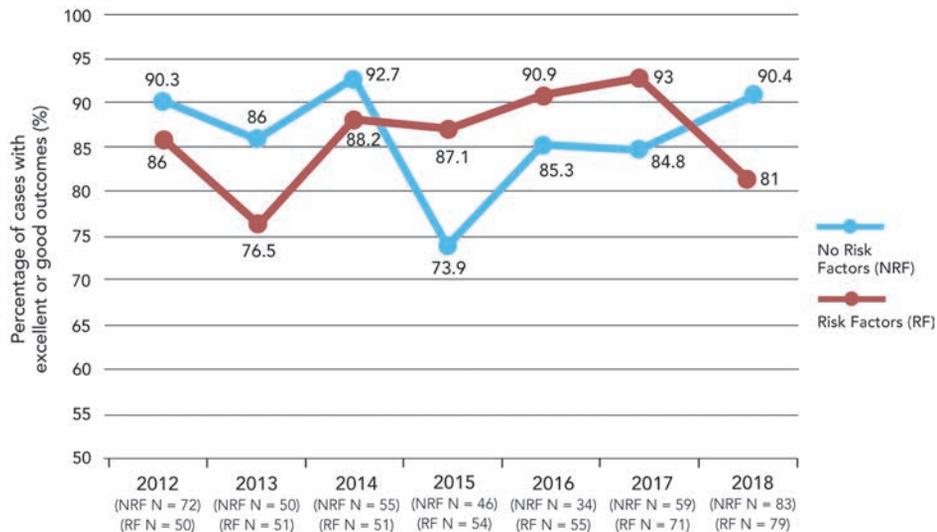
### Exotropia Outcomes Stratified by Goal

In 2018, 162 patients with exotropia underwent strabismus surgery. Of these, 49 patients had surgery to restore binocular vision (binocular potential), 88 patients had reconstructive surgery for normalizing eye contact, and 21 patients had surgery to eliminate double vision (diplopia). The success rates (excellent or good outcomes) were 85.2%, 85.7%, and 85.7%, respectively. Four surgeries performed to resolve torticollis have been excluded from this analysis due to the small number.



### Exotropia Outcomes Stratified by Risk Factors

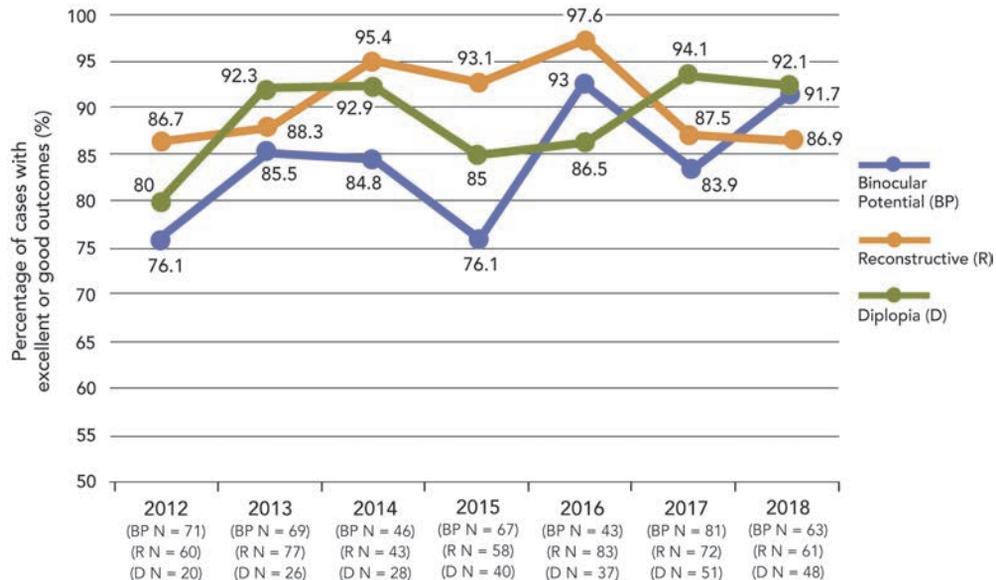
Of the 162 patients with exotropia, 79 patients had associated risk factors, and 83 patients had no associated risk factors. Risk factors include the following: bilateral vision limitation (e.g. albinism), conditions resulting in hyper- or hypotonia, craniosynostosis or craniofacial anomalies, 3<sup>rd</sup> nerve palsy, 4<sup>th</sup> 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. In the presence of these complicating conditions, 81.0% 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.<sup>1</sup>



Reference: <sup>1</sup>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 2018, 219 patients with esotropia underwent strabismus surgery. Of these, 75 patients had surgery to restore binocular vision (binocular potential), 77 patients had reconstructive surgery for normalizing eye contact, and 62 patients had surgery to eliminate double vision (diplopia). The success rates (excellent or good outcomes) were 89.7%, 87.0%, and 93.6%, respectively. Five surgeries performed to resolve torticollis, four of which were complicated, have been excluded from this analysis due to the small number.



## Esotropia Outcomes Stratified by Risk Factors

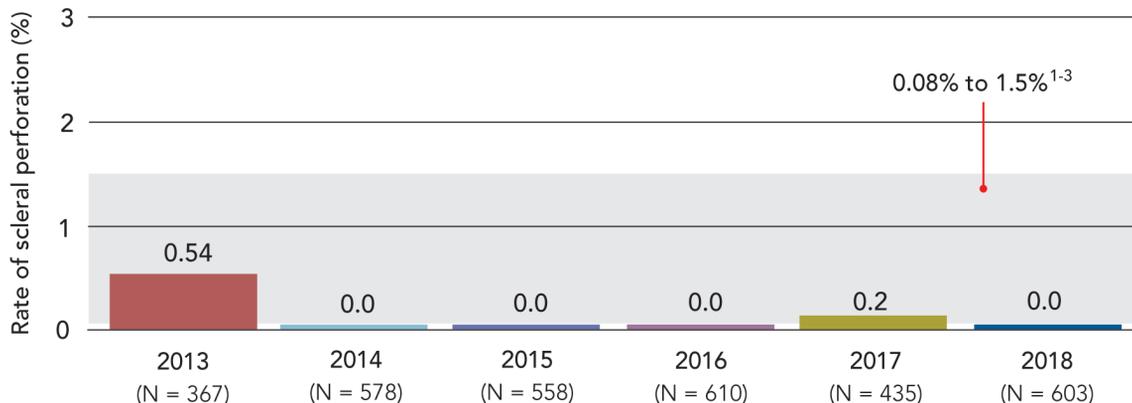
Of the 219 patients with esotropia, 102 patients had associated risk factors, and 117 patients had no associated risk factors. Despite these complicating conditions, 87.3% of strabismus surgeries for esotropia with an above risk factor had excellent or good outcomes as defined by the metrics published by Chang et al.<sup>1</sup>



## 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 give rise to retinal detachment in some cases.

Of the 603 strabismus procedures performed in 2018, there were no cases of scleral perforation.



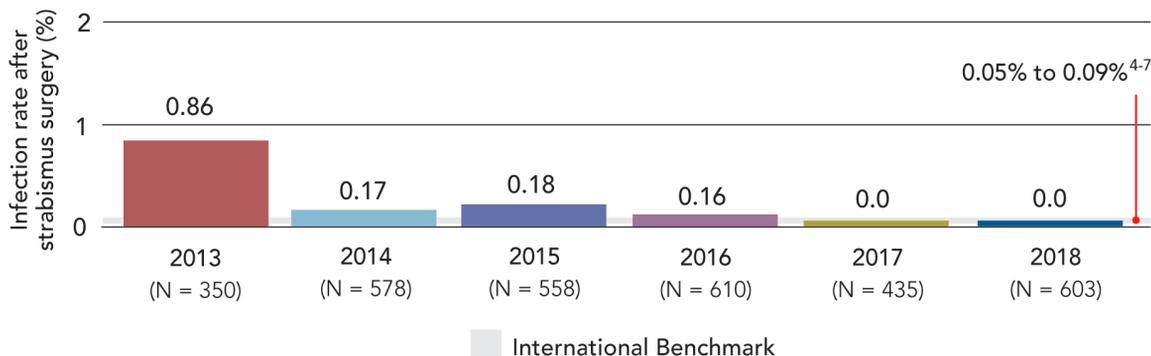
References: <sup>1</sup>Bradbury JA. What information can we give to the patient about the risks of strabismus surgery. *Eye (Lond)* 2015; 29(2): 252-257. <sup>2</sup>Awad AH, Mullaney PB, Al-Hazmi A, et al. Recognized globe perforation during strabismus surgery: incidence, risk factors, and sequelae. *J AAPOS* 2000; 4(3): 150-153. <sup>3</sup>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 2018, there were no postoperative infections reported for strabismus surgery. In calendar years 2014, 2015 and 2016, one of 578 procedures was complicated by a suture abscess, one of 558 was complicated by a postoperative pre-septal cellulitis, and one of 610 procedures was complicated by postoperative pyomyositis of an extraocular muscle, respectively.

There were no postoperative infections for pediatric cataract and ptosis surgery procedures in calendar year 2018, which has been consistent since reporting began in 2013.<sup>8-11</sup>



References: <sup>4</sup>Ing MR. Infection following strabismus surgery. *J Ophthalmic Nurs Technol* 1991; 10(5): 211-214. <sup>5</sup>Bradbury JA. What information can we give to the patient about the risk of strabismus surgery. *Eye (Lond)* 2015; 29(2): 252-257. <sup>6</sup>Brenner C, Ashwin M, Smith D, et al. Sub-Tenon's space abscess after strabismus surgery. *J AAPOS* 2009; 13(2): 198-199. <sup>7</sup>Bradbury JA, Taylor RH. Severe complications of strabismus surgery. *J AAPOS* 2013; 17(1): 59-63. <sup>8</sup>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. <sup>9</sup>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. <sup>10</sup>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. <sup>11</sup>Lee EW, Holtebeck AC, Harrison AR. Infection rates in outpatient eyelid surgery. *Ophthalm Plast Reconstr Surg* 2009; 25(2): 109-110.

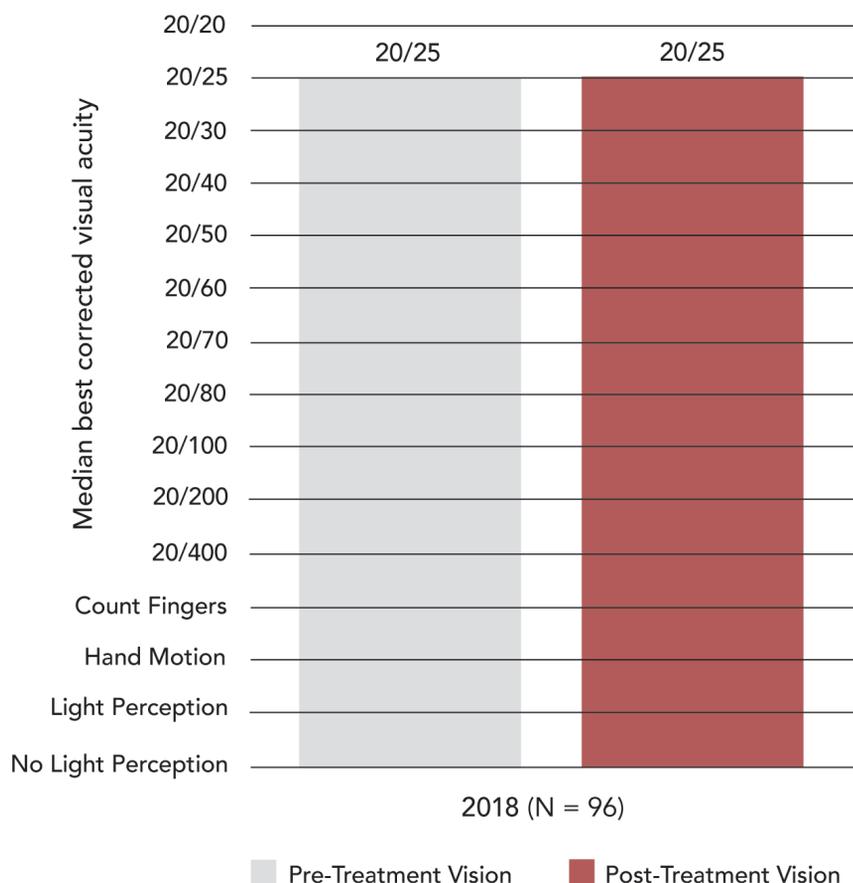
## Ocular Immunology and Uveitis Service

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.

### Median Post-Treatment Vision for Acute Anterior Uveitis

During calendar year 2018, 344 patients presented with acute anterior uveitis to the Mass. Eye and Ear Emergency Department (ED). Of these 344 patients, 84 had a follow-up within one month of their ED visit at the Mass. Eye and Ear Ocular Immunology and Uveitis Service. In general, patients with uveitis with perceived higher acuity in the ED are referred to the Uveitis Service; other patients with uveitis are followed by the Comprehensive Ophthalmology Service.

The nationally established IRIS measure for acute anterior uveitis (IRIS51) by the American Academy of Ophthalmology (updated 1/2019) defines treatment success as achievement of best corrected visual acuity of 20/20 or better or back to baseline within 90 days of treatment. The majority of patients who presented to our ED were new and as such did not have a baseline vision. Therefore, instead, visual acuity was recorded for those 84 patients at presentation to the ED and compared to their visual acuity at their post-treatment follow-up visit closest to three months. Ninety-six eyes of 84 patients were included in the following analysis. The median pre-treatment vision (vision at presentation) and the median post-treatment vision was 20/25.



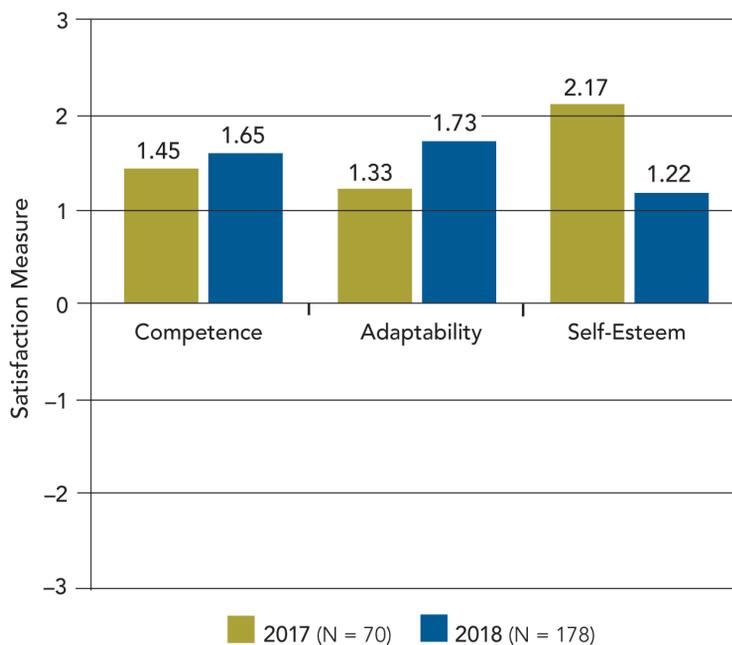
## Vision Rehabilitation Service

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.

### Vision Rehabilitation Service: Psychosocial Impact of Assistive Devices Scale

Psychosocial impact of assistive devices (PIADS) has been the primary quality outcome measure for the Vision Rehabilitation Service since 2017. It consists of 26 items of a few words or less (i.e. "competence," "happiness," "independence," "embarrassment") where the patient is asked to rate their vision assistive device as decreasing (0 to -3) or increasing (0 to +3) that term. Over the past 20 years, the PIADS has gained favor in various fields of rehabilitation research and clinical practice. It is easy to administer and does not require pre- and post-rehabilitation administration.<sup>1</sup>

During calendar year 2018, there were 700 new vision rehabilitation patients. Of these, 25.4% (n = 178) took part in the PIADS questionnaire looking at the impact of a prescribed assistive device (i.e. smart glasses or hand-held magnifying device). 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 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.<sup>2</sup> Of the 178 patients who took part in the questionnaire at the Mass. Eye and Ear Vision Rehabilitation Service, 19 listed a CCTV as their assistive device. Average PIADS scores of these 19 patients were 2.22, 2.03, and 1.61 for competence, adaptability, and self-esteem, respectively, which all exceed these benchmark values. Furthermore, no significant differences in impact values were reported for the different magnification devices. Smartphones were reported frequently by patients as being their most useful assistive device (n = 21) and had the highest combined PIADS score of all devices (6.07).



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

Photo by Pierce Harman.

References: <sup>1</sup>Jutai J, Day H. Psychosocial impact of assistive devices scale (PIADS). *Technol Disabil* 2002; 14:107-111. <sup>2</sup>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.

## Ophthalmology Medical Staff and Practice Locations

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# Appendix

Department	Description of Change Compared to Prior Years
<b>EMERGENCY DEPARTMENT</b>	
Distribution of Ophthalmology Diagnoses	The top 20 urgent diagnoses seen in the Emergency Department were reported after analyzing the primary listed diagnosis for the initial visits.
<b>EYE TRAUMA SURGERY</b>	
Ocular Trauma Score and Final Visual Acuity	New outcome measure.
<b>GLAUCOMA SURGERY</b>	
Intraoperative Complications	Postoperative day 1 complications are included along with intraoperative complications.
<b>REFRACTIVE SURGERY</b>	
SMILE for Myopia: Achieving Target Refraction (Spherical Equivalent)	New outcome measure.
<b>OCULAR IMMUNOLOGY AND UVEITIS SERVICE</b>	
Percentage of Patients on Systemic Immunomodulatory Therapy	Removed in favor of new outcome measure.
Median Post-Treatment Vision	New outcome measure.

Photo by Garyfallia Pagonis.



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