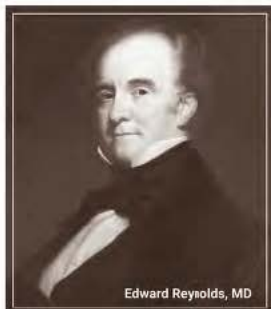


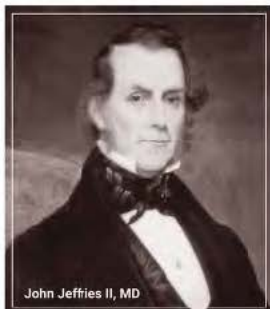
A Legacy of Healing, a Future of Hope: 200 Years of Mass Eye and Ear

On October 1, 1824, two young doctors named **Edward Reynolds, MD**, and **John Jeffries II, MD**, took it upon themselves to treat the eye diseases of the Boston poor at a free public clinic.

Between 1820 and 1850, the city's population exploded from 43,000 citizens to 137,000, a more than three-fold increase. The majority of this growth was due to immigrants from Europe who came to Boston seeking a better life for themselves and their families. Many who came were laborers working for the booming regional textile, railroad, shipping and



Edward Reynolds, MD



John Jeffries II, MD

other industries—carpenters, masons, blacksmiths and sailors. This group of people was most likely to suffer from occupation-related injuries, and were least likely to afford medical care.

Reynolds and Jeffries were both empathetic men with a strong sense of social justice. They recognized that if people could have early access to free quality eye care, many diseases leading to blindness could be completely prevented. They rented one small room, one afternoon a week in the Scollay Building in Boston's West End, and the Boston Eye Infirmary (now Mass Eye and Ear) was born. In the first 15 months, 859 patients sought treatment; 777 for eye diseases and 82 for ear diseases.

The hospital soon became a magnet for ophthalmologists and otolaryngologists who wanted to practice the highest quality medicine and surgery. Mass Eye and Ear is recognized today as an international leader in clinical care, research, education and community service.



1850



1960



2024



(a) Aural surgical staff, 1909. (b) Former Chief of Otorhology and Laryngology at Mass Eye and Ear and Massachusetts General Hospital, Joseph B. Nadol, Jr., MD, trains residents on how to perform a stapedectomy in the surgical training laboratory. (c) A 3-D printed simulation model of a patient with Eustachian tube dysfunction which gives trainees the opportunity to practice accessing the sinuses and Eustachian tube, as well as practice surgical techniques.

Clinical Care

EARLY INNOVATIONS

While Mass Eye and Ear began its work as a charitable institution for eye care, it quickly emerged that many patients also sought treatment for diseases related to the ear. Many hospital physicians and surgeons became early pioneers in ear disease treatment, including **Frederick L. Jack, MD**. In 1892, Jack became the first doctor in the United States to perform an operation known as a stapedectomy in patients with abnormal bone growth in the middle or inner ear. The hope was that by removing the small stapes bone in the middle ear, hearing would be restored. Early stapedectomies were largely unsuccessful, but thanks to modern antibiotics, tools and techniques, stapes surgery has evolved into an effective treatment for hearing loss. In 1962, **William W. Montgomery, MD**, introduced a device called a T-Tube that kept the trachea open and allowed healing following surgical reconstruction. The T-Tube is just one of the many clinical innovations that would come from Montgomery during his long career.



□ In 1963, Harold F. Schuknecht, MD, developed a Teflon-wire piston stapes prosthesis. When placed in the inner ear following stapes surgery, it helps restore hearing in patients with conductive hearing loss. The bottom image shows the prosthesis in place.

COLLABORATIVE APPROACH TO A NOVEL SURGICAL TREATMENT

Historically, the conventional approach for removing a tumor of the posterior orbit (eye socket) involved a difficult and risky surgical procedure close to the eye, through

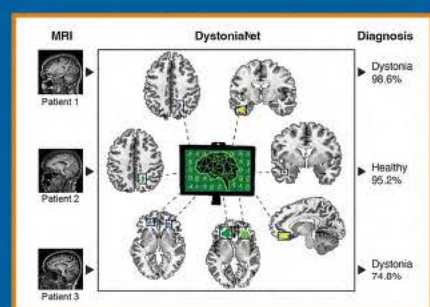


■ Magnetic Resonance Imaging (MRI) images of two different right orbital tumors classified as "Orbital Resection by Intranasal Technique (ORBIT)" Class II in the front of the orbit or Class III in the back of orbit. The yellow arrows point to the lesions.

the orbit. However, in 2017, when an 11-year-old patient came to Mass Eye and Ear with a bulging eye caused by an orbital tumor, two surgical colleagues developed an innovative approach to remove the tumor. Endoscopic skull base surgeon **Benjamin S. Bleier, MD**, and ophthalmic plastic surgeon **Suzanne K. Freitag, MD**, developed a minimally invasive endoscopic procedure that accessed the orbit through the adjacent sinus, lowering the risk of damage to the eye. This procedure, which was one of the first of its kind, results in a shorter hospital stay, less pain and improved function and appearance for patients.

LOOKING AHEAD: PREDICTIVE MEDICINE

Artificial intelligence (AI) in diagnosis and treatment is growing and ushering in a new era of practicing predictive medicine. Mass Eye and Ear researchers are using AI to develop new tools for conditions of the throat, head and neck. **Kristina Simonyan, MD, PhD, Dr med**, and team have leveraged AI to create new tools called DystoniaNet and DystoniaBoTXNet, the first technologies to enable fast and accurate diagnosis of laryngeal dystonia—a neurological condition that involuntarily contracts the vocal cords causing severe speech difficulties—and predict who might benefit from botulinum toxin (Botox) injections, the standard treatment. In addition, **Sophia Z. Shalhout, PhD**, and members of her lab are designing and developing novel software capable of creating computer simulations of a patient's specific head, neck and skin cancer. Such models can be used to predict the best treatment options available to a specific patient. These simulations hold the ability to 'test' outcomes virtually, before treating a patient.



"We must ensure patients receive an accurate diagnosis and proper treatment as quickly as possible after their symptoms onset. This research journey has been truly exhilarating, revealing the positive aspects of AI capable of accelerating the delivery of better care for dystonia patients."

— Kristina Simonyan, MD, PhD, Dr med, Vice Chair of Clinical Research, Department of Otolaryngology—Head and Neck Surgery.

■ In a fraction of a second, the AI-powered DystoniaNet platform can analyze raw MRI data to diagnose dystonia.



(a) M. Charles Liberman, PhD, former Director of the Eaton-Peabody Laboratories (EPL), examines noise-induced damage to the sensory cells of the inner ear using a confocal microscope. (b) Harris P. Mosher, MD, (right, standing) teaches students in his post-graduate course on head and neck anatomy, 1932. (c) Robert S. Kimura, MD, in the Electron Microscopy Laboratory, 1963. (d) H & E staining in a dish of terpineol, a technique used to visualize cellular and tissue structures, conducted in the Otopathology Laboratory. For closer observation, the tissue is placed on a 1 x 3-inch glass slide. (e) Louise Clarke, laboratory technician, works in the EPL, 1960s. (f) Daniel B. Polley, PhD, Director of the EPL, focusing a two-photon microscope, used to measure calcium signals from hundreds of auditory cortex neurons as mice listen to environmental and phantom sounds. (g) Demonstration of a position for X-raying the sinus, 1937.

Research

SPEARHEADING HEARING INITIATIVES

In 1871, a young inventor approached Mass Eye and Ear's Chief of Otology **Clarence J. Blake, MD**, with a complicated question: how do vibrations in the air produce sound that humans can hear? Blake met with the man, providing a specimen for study from Harvard Medical School's temporal bone collection. As he studied Blake's work, the young man found the answers to his question. In 1876, that inventor, Alexander Graham Bell, filed a patent for his telephone and changed the way people communicate forever.



When **Nelson Y. S. Kiang, PhD**, established the Eaton-Peabody Laboratories (EPL) in 1958, he knew that for doctors to better understand and restore hearing, collaboration with basic scientists and engineers would be needed. He assembled a multidisciplinary team to join him in his groundbreaking research into the way the brain processes sound. As a pioneer in utilizing computers in neurosciences, Kiang installed one of the earliest computers in

the EPL in 1962 and used it to gather data for his influential textbook on the auditory-nerve response, published in 1965.



■ Alexander Graham Bell



■ The phonautograph, a mechanical instrument devised by Clarence J. Blake, MD, and Alexander Graham Bell that incorporated a human ear to visually capture sound waves. Illustration (colorized) from: Theodore Du Moncel's *The telephone, the microphone and the phonograph*. 1879.

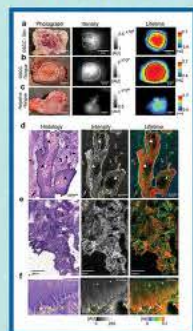


EXPLORING GENETIC HEARING LOSS

Finding effective treatments for hearing loss has long been difficult; once the sensory cells in the inner ear—known as hair cells—are damaged or destroyed, the body is unable to regenerate or replace them. Hair cell loss, which can be caused by aging, noise exposure and other factors, often contributes to permanent hearing loss. A research team led by **Zheng-Yi Chen, DPhil**, of the Eaton-Peabody Laboratories, created a drug-like cocktail of different molecules, and when administered directly into the inner ear, it successfully regenerated lost hair cells in a mouse model by

reprogramming a series of genetic pathways. The outcome of this revolutionary study demonstrates the promise of gene therapy for treating incurable conditions such as hearing loss.

BENCH TO BEDSIDE INNOVATIONS



Mass Eye and Ear scientists are spearheading research to personalize surgery and determine the presence of lingering cancer cells, advancing future treatments for head and neck cancers. **Anand T. N. Kumar, PhD**, and team are developing what may be groundbreaking surgical imaging technology to provide operating room surgeons with real-time molecular-based imaging of cancer tumor margins at nearly 100% accuracy. This technology, which provides a more effective way to

identify tumor tissue, could lead to more accurate and less invasive cancer treatments.



Daniel L. Faden, MD, FACS, and team have developed one of the first and most reliable blood tests for human papillomavirus-associated head and neck cancers. This liquid biopsy can identify remaining

circulating tumor DNA after surgery, monitor a patient's response to treatment in real time and discover recurrence months to years before clinical detection.



(a) Stéphane F. Maison, PhD, CCC-A, CH-TM, Director of the Tinnitus Clinic, conducting an auditory-evoked potential test on a study participant to observe auditory nerve responses, looking for signs of deficits. (b) Voice therapist Mary Doehler teaches esophageal speech to a patient, circa 1949.

Community

PIONEERING SURGICAL TECHNIQUES FOR GREATER GOOD

Shortly after World War I, Mass Eye and Ear found itself at the forefront of the rapidly modernizing field of facial reconstructive surgery, thanks to **Varaztad H. Kazanjian, DMD, MD**. A Harvard-trained dentist and physician, Kazanjian served in the Harvard Medical Corps in France, where he saw the brutality of war firsthand. Thousands of young men, many with devastating facial injuries, were in desperate need of reconstructive procedures. Using his background in dentistry to his advantage, Kazanjian pioneered innovative surgical techniques and methods for creating more advanced prosthetics to restore the function and appearance of patients' faces. In 1930, he became the first head of Plastic Operations at Mass Eye and Ear, and in 1941 he was named the first Professor of Plastic Surgery at Harvard Medical School.



Varaztad H. Kazanjian, DMD, MD, used his surgical skills to treat severely injured soldiers during World War I. One way in which he documented his reconstructive procedures was through moulages, molds of patients' faces created at different stages of their injury and recovery. This photograph shows several displayed in Camiers, France. Warren Anatomical Museum collection, Center for the History of Medicine in the Francis A. Countway Library, Harvard University.



David A. Shaye, MD, MPH, FACS, carries a child with a cleft lip into the operating room where he will perform surgery to restore the child's lip and reduce stigma, 2015.

GLOBAL SURGERY EFFORTS

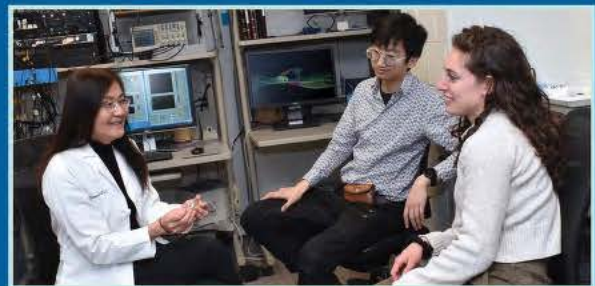
The research and clinical work of Mass Eye and Ear is world-renowned and is buoyed by its mission to educate and train surgeons in underserved areas and help build sustainable healthcare infrastructures in their communities. Throughout his career, facial plastic and reconstructive surgeon **David A. Shaye, MD, MPH, FACS**, has travelled to Africa, Asia and South America to collaborate with and teach surgeons to improve surgical care, caring for patients with a range of facial deformities and trauma. The Global Surgery Scholars Program at Mass Eye and Ear, launched by Shaye in 2023, offers junior surgeons the opportunity to observe surgeries, attend lectures and receive mentorship in research. Three surgeons from Zimbabwe, Nepal and Colombia each spent one month at the hospital during the inaugural program, returning home to teach the next generation of surgeons.

ADVANCING INCLUSIVITY ENDEAVORS

Mass Eye and Ear is committed to ensuring that otolaryngology care is accessible to everyone. Partnering with the Boston Health Care for the Homeless Program (BHCHP), practicing attendings and resident physicians see a population of patients experiencing homelessness at the monthly BHCHP clinic, where they provide specialty care for the ear, nose, throat, head and neck. This initiative, led by **Mark A. Varvares, MD, FACS**, Chair of Otolaryngology-Head and Neck Surgery at Mass Eye and Ear and Massachusetts General Hospital, and **Gregory W. Randolph, MD, FACS, FACE**, Director of the Thyroid and Parathyroid

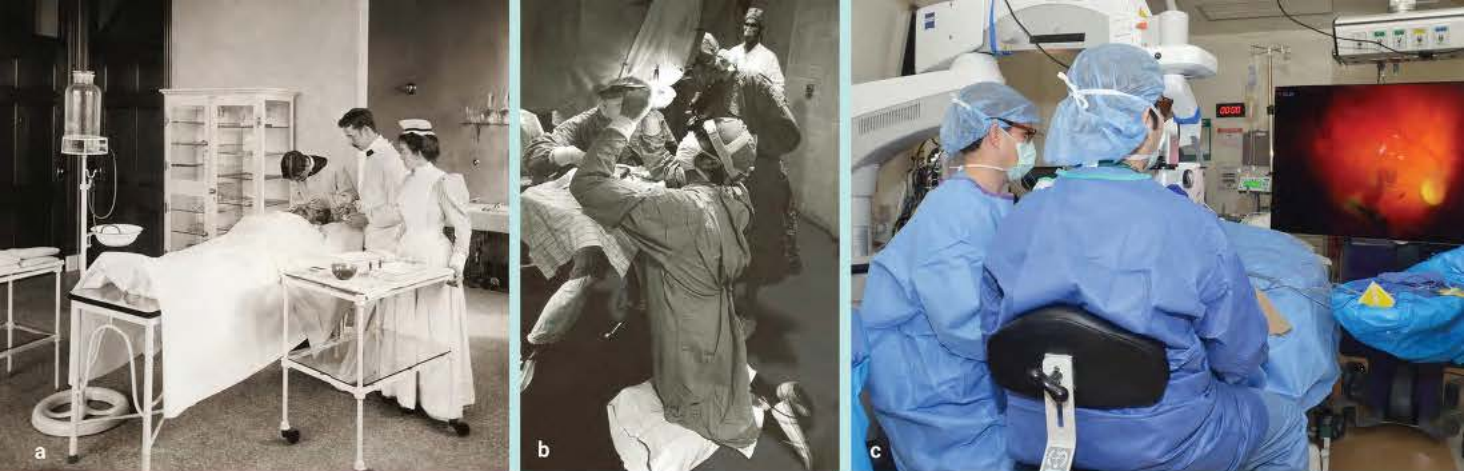


Endocrine Surgical Division at Mass Eye and Ear, has inspired the planned development of a homeless medicine specialty in the Department of Otolaryngology-Head and Neck Surgery.



"Continuing to foster an inclusive environment within the department is critical. In the summer of 2024, one of the initiatives taking place in the Eaton-Peabody Laboratories includes research faculty hosting underrepresented students in medicine, through the MGH Summer Research Trainee Program and the HMS Visiting Research Internship Program. These intended annual programs will contribute to diversifying academic medicine."

—Heidi Nakajima, MD, PhD, Vice Chair of Diversity, Equity and Inclusion for the Department of Otolaryngology-Head and Neck Surgery.



(a) Ophthalmic surgery in the operating room, 1900. (b) Giant retinal tear surgery using an inversion operating table, 1960s. (c) Modern retinal surgery using the NGENUITY 3D Visualization System, 2017.

Clinical Care

VISIONARY BEGINNINGS

Mass Eye and Ear has a rich history, founded on the principle of caring for the community and providing free access to eye care for those in need. In 1824, at the cusp of enormous advances in the diagnosis and treatment of eye diseases, **Edward Reynolds, MD**, and **John Jefferies II, MD**, established the Boston Eye Infirmary in a rented room in Boston's Scollay Square. Patient demand in the first two years led the hospital to expand to become the Massachusetts Charitable Eye and Ear Infirmary in 1827 and formed the nucleus of the Harvard Medical School Department of Ophthalmology in 1871.



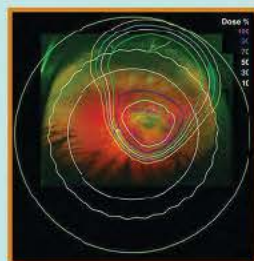
■ Scollay Building, Boston's West End.

THE BIRTH OF SUBSPECIALTIES

The introduction of the ophthalmoscope in 1850 revolutionized the study of the eye, enabling a much deeper understanding of its structure and function. By the mid-20th century, there was a significant growth in ophthalmologic subspecialties, three of which were established by Mass Eye and Ear physicians:



- After joining the institution in 1947, **Charles L. Schepens, MD**, considered the father of modern retinal surgery, founded the world's first retina service.
- In 1955, renowned glaucoma experts **Paul A. Chandler, MD** (left), and **W. Morton Grant, MD** (right), founded the Glaucoma Consultation Service.
- In 1958, **Claes H. Dohlman, MD, PhD**, joined Mass Eye and Ear, and shortly thereafter, he established the world's first cornea service.



PIONEERING VISION-SAVING TREATMENTS

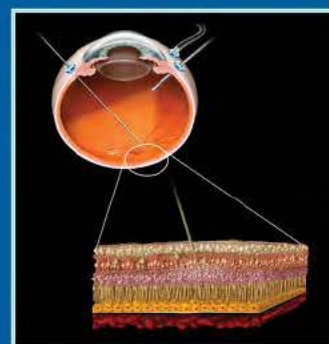
Mass Eye and Ear clinicians and researchers are responsible for numerous innovations that have saved the sight or improved the vision of millions of people worldwide. These include the development of photodynamic therapy with verteporfin (a light-activated drug) and anti-vascular endothelial growth factor (VEGF) therapies for age-related macular degeneration and other retinal disorders, as well as the Boston Keratoprosthesis (KPro) artificial cornea. Faculty also developed ocular coherence tomography, which takes cross-sectional pictures of the back of the eye to help with diagnosis.

- Developed in 1975 by **Evangelos S. Gragoudas, MD**, proton beam irradiation is a focused form of radiation that is particularly effective for treating tumors near critical parts of the eye.

CLINICAL INNOVATIONS OF THE FUTURE

"With a focus on areas of greatest unmet need, we are driving major clinical innovations in gene-based and precision medicine, advanced imaging techniques, and biologic therapies that will ultimately reshape how we diagnose and treat eye conditions. These advancements will not only improve patient outcomes, but also pave the way for more tailored and efficient care."

—Joan W. Miller, MD, Chair of Ophthalmology, Harvard Medical School, Mass Eye and Ear, and Mass General Hospital;
Ophthalmologist-in-Chief, Brigham and Women's Hospital.



■ Gene therapy being applied to the light-sensitive cells in the retina.



(a) Laboratory technician Gretchen Heidle at work in the Eye Pathology Laboratory, 1956. (b) Researcher working in the laboratory at the Grousbeck Gene Therapy Center, 2020.

Research

A POWERHOUSE FOR TRANSLATIONAL RESEARCH

Mass Eye and Ear serves as the flagship research and teaching hospital of the Harvard Department of Ophthalmology, uniting researchers from three long-established laboratories across the institutions. Today, these and other labs continue to translate bench-to-bedside research into better treatments and new cures for blinding diseases.



■ The Howe Laboratory, established in 1926, was the first endowed ophthalmology research laboratory in the United States and was initially led by pathologist and researcher **Frederick H. Verhoeff, MD**. Pictured above, from left: Jin H. Knoshiba, PhD; W. Morton Grant, MD; Toichiro Kuwabara, MD, PhD; and David G. Cogan, MD.

■ In 1974, the Berman-Gund Laboratory for the Study of Retinal Degenerations was founded under the leadership of **Elion L. Berson, MD** (above left). With philanthropic support from Gordon Gund, Bernard Berman, and the Foundation Fighting Blindness, this was the first laboratory in the world to study inherited retinal degenerations (IRDs). To date, researchers have identified 20+ genes linked to IRDs and are working to develop therapies for these blinding disorders.

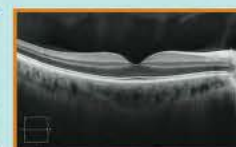
■ In 2011, Mass Eye and Ear joined with Schepens Eye Research Institute to form the world's largest basic and clinical ophthalmology research enterprise. Each year, Mass Eye and Ear consistently ranks among the top two recipients of National Eye Institute research funding nationwide. Above, researchers use PCR technology to amplify DNA.

SEMINAL DISCOVERIES

Groundbreaking discoveries in various fields, including genetics, immunology, and ocular biology, have reshaped the foundations of ophthalmology and created new avenues for the repair, regeneration, and rehabilitation of countless disorders. Renowned cornea specialist **Claes H. Dohlman, MD, PhD**, developed the Boston Keratoprosthesis (KPro), which was approved by the U.S. Food and Drug Administration in 1992 and is still the most widely used artificial cornea. In the 1990s, researchers at Mass Eye and Ear pioneered the use of optical coherence tomography (OCT) and fundus autofluorescence, two of the most widely used imaging tools in retina care. **Thaddeus P. Dryja, MD**, an expert in eye pathology and genetics, identified the first tumor-suppressor gene (Rb)—an important cornerstone in understanding the molecular basis of cancer. Mass Eye and Ear researchers have also discovered more than 200 genes linked to various eye diseases.



■ The latest Boston KPro, the Type I Lucia, approved by the U.S. FDA in 2019.



■ OCT image of healthy retina.

TRANSLATIONAL RESEARCH: A VISION FOR THE FUTURE

Scientific collaboration across disciplines is rapidly advancing the understanding of blinding diseases and uncovering new targets for therapy. Exciting discoveries are being made in gene-based and regenerative therapies, imaging and artificial intelligence, and clinical data science.



"Building on this momentum, our research strategy targets promising areas, including retinal degenerations, macular degeneration, and diabetic eye disease, as well as optic neuropathies, particularly glaucoma. We are also actively pursuing programs in other critical areas, including cornea and ocular surface, oncology, immunology, infectious disease, and vision rehabilitation."

—Patricia A. D'Amore, PhD, MBA, Associate Chief for Ophthalmology Basic and Translational Research, Mass Eye and Ear.



(a) Simmons Lessell, MD, presenting to trainees at Grand Rounds, 2012. (b) Mass Eye and Ear ophthalmology residents, 1974.

Education

THE WORLD'S FIRST SUBSPECIALTY FELLOWSHIPS

Mass Eye and Ear established the world's first clinical fellowship programs in retina, cornea, and glaucoma. Today, 15 clinical fellowship programs are offered in all ophthalmology subspecialty areas.

WOMEN IN OPHTHALMOLOGY: A HISTORY OF FIRSTS

Since the late 1800s, women have been at the heart of Mass Eye and Ear, but like many medical institutions of the time, women initially held nursing and administrative roles. **Maud Carvill, MD**, was the first woman on the surgical staff at Mass Eye and Ear when she was appointed in 1921, followed by **Edith Ives Cogan, MD**, in 1928. In the 1960s, social change created more opportunities for women.



■ Maud Carvill, MD
■ Edith Ives Cogan, MD



■ In 1959, former retina fellow **Alice R. McPherson, MD**, (seen here with her mentor Charles L. Schepens, MD), became the first woman vitreoretinal surgeon in the world.



■ **Deborah Pavan-Langston, MD**, became the first woman accepted into the Mass Eye and Ear (now Harvard) Ophthalmology Residency Training Program in 1966 and the first woman to complete a Mass Eye and Ear cornea fellowship in 1970. In 1973, she became the first woman to direct the Mass Eye and Ear Cornea Service.



■ **Ilene K. Gipson, PhD**, a senior scientist at Mass Eye and Ear, became the first woman promoted to Professor of Ophthalmology at Harvard Medical School in 1997.



■ In 2002, **Joan W. Miller, MD**, became the first woman physician to achieve the rank of Professor of Ophthalmology at Harvard Medical School. A year later, she was appointed the first woman Chief of Ophthalmology at Mass Eye and Ear and Chair of Ophthalmology at Harvard Medical School.



AN INNOVATIVE SURGICAL CURRICULUM

The Ophthalmology Department leads the nation in developing an innovative and challenging surgical curriculum for ophthalmology residents. Within the past 20 years, the department launched the first annual national cataract surgery course; developed the Stepwise cataract surgery curriculum that emphasizes gradual, hands-on training; and established the Cataract Master, a digital cataract surgical training tool now available nationally to American Academy of Ophthalmology members. Mass Eye and Ear is also home to the **Samuel and Nancy Jo Altschuler Ophthalmology Surgical Training Laboratory**, which offers state-of-the-art surgical simulation training in a realistic preoperative environment.

TRANSFORMING OPHTHALMOLOGY EDUCATION FOR FUTURE GENERATIONS

"As we look to the future, our education and faculty development strategy targets key challenges in ophthalmology, including the need for a more diverse workforce. Evidence shows that diversity enhances decision-making, fosters a deeper understanding of patients' needs and values, and ultimately results in improved outcomes. We also continue to expand our virtual and collaborative learning tools, and increase wellness resources that support work-life balance and mental health."

—Alice C. Lorch, MD, MPH, Program Director, Harvard Ophthalmology Residency Training Program.