Future Directions in Cochlear Implants
Researchers develop technology that makes possible fully implantable cochlear implant
(page 16)
News from the Department of Otolaryngology at Harvard Medical School

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Please send comments, requests for additional copies and other inquiries regarding this issue to:

Suzanne Day
Communications Manager
Department of Otolaryngology
Massachusetts Eye and Ear
243 Charles Street, Boston, MA 02114
Ph: 617-573-3897 | suzanne_day@meei.harvard.edu

Contributors

Editor-in-Chief
D. Bradley Welling, M.D., Ph.D., FACS
Walter Augustus LeCompte Professor and Chair of Otology and Laryngology
Harvard Medical School

Managing Editor/Writer
Suzanne Day

Design/Layout/Photography
Garyfallia Pagonis

On the cover: Researchers from Mass. Eye and Ear/ Harvard Medical School and the Massachusetts Institute of Technology have developed a prototype system-on-chip that makes possible a fully implantable cochlear implant.

Cover photo by Garyfallia Pagonis.

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Dear colleagues and friends,

Over the past several decades, cochlear implants have not only impacted the lives of some of our profoundly deaf patients, they’ve also presented new challenges and opportunities for us in our field.

Globally recognized as the most successful neural prosthesis currently available, with more than 350,000 patients worldwide currently using the technology (and tens of millions more who would benefit), cochlear implantation is no longer considered an experimental medical procedure for our community.

But that has not stopped us from continuing to push for further improvements. The indications for the procedure are expanding, as we work to advance the technology far beyond what any of us could have imagined when they were first introduced.

When Donald Eddington, Ph.D., brought the Ineraid to the Harvard Medical School community in the late 1970s, partnering with Joseph B. Nadol, Jr., M.D., to integrate cochlear implants into practice at Mass. Eye and Ear/Harvard Medical School, he opened doors for the New England region to the then-new technology. Our institution is forever grateful to them and to John Anderson, their courageous first research subject, for taking that first step. You can read more about their story starting on page 12 of this issue.

Today, our researchers continue to develop and refine sensory prostheses, including the cochlear implant, for the treatment of profound deafness. In 2014, a team including Konstantina Stankovic, M.D., Ph.D. — who began her auditory career working in Dr. Eddington’s cochlear implant lab — introduced a prototype system-on-chip (SoC) that could make possible a fully implantable cochlear implant. The technology would not only offer the cosmetic benefit of an invisible prosthesis, but it may also facilitate better sound localization. In our cover story starting on page 16, we outline the progress Dr. Stankovic has made with her collaborators at the Massachusetts Institute of Technology in developing a fully implantable cochlear implant.

In this issue, we’re excited to share with you an important part of our history and our current progress in the area of cochlear implants, but we’re also excited about a number of other advances across the field. As you read through the pages of our spring issue, I hope you connect with the many ways that otolaryngology physicians and researchers at Harvard Medical School are contributing to our shared success through exceptional clinical care, research and teaching advancements.

Thank you for your interest in and support of the Department’s activities.

Sincerely,

D. Bradley Welling, M.D., Ph.D., FACS
Albert Edge, Ph.D., Promoted to Professor of Otology and Laryngology at Harvard Medical School
Also named first incumbent of new HMS Chair
The Department recently celebrated the promotion of Albert Edge, Ph.D., Director of the Tillotson Cell Biology Unit in the Eaton Peabody Laboratories at Mass. Eye and Ear, to Professor of Otology and Laryngology at Harvard Medical School. Dr. Edge was also named the first incumbent of a new Harvard Medical School endowed chair. Colleagues, family and friends recently gathered to honor Dr. Edge during a reception at the Harvard Faculty Club.

The promotion represents more than three decades of dedication and an array of contributions to the field of regenerative medicine from Dr. Edge, who first joined the Department in 2003 as an Investigator and Lecturer in Otology and Laryngology. He completed his undergraduate training in biology (summa cum laude) at the State University of New York at Albany in 1976 and went on to earn a Ph.D. in biochemistry at Albany Medical College of Union University in 1980. He then came to Harvard Medical School as a postdoctoral fellow in biological chemistry at the Joslin Research Laboratory in 1981, studying the role of sugars in protein binding, the antigenicity of tumor antigens and vaccine development.

He joined the faculty of Harvard Medical School in 1985 as Instructor in Medicine and began to combine his work on glycobiology with an emerging interest in regenerative medicine. Initiated by a study of the role of carbohydrates in transplant rejection, his laboratory was one of the first to recognize the possibility of using stem cells in regeneration. He went on to pursue these interests in industry, working primarily on cellular repair in Parkinson’s disease and in heart failure.

He soon became interested in the prospect of cellular replacement in the auditory system. A collaborative project with M. Charles Liberman, Ph.D., Director of the Eaton-Peabody Laboratories at Mass. Eye and Ear, working to rebuild the afferent system by transplanting auditory neurons, inspired him to return to academia in 2003.

Dr. Edge most recently demonstrated in a 2013 issue of Neuron that pharmacological inhibition of the Notch pathway induces new hair cells in the inner ear, resulting in a partial recovery of hearing. The data presented in the paper showed hair cell regeneration in the adult mammalian ear for the first time, representing a promising step toward developing a drug for the treatment of hearing loss.

His laboratory’s discovery has since inspired further research on this method of hair cell regeneration in other laboratories around the world. Dr. Edge has been featured in the Boston Globe, NPR, BBC and numerous other publications in light of this discovery. The importance of the work has also attracted the enthusiasm of graduate students and postdoctoral fellows, whom Dr. Edge is dedicated to mentoring in the laboratory.

“We couldn’t be more proud of Dr. Edge and his work,” said D. Bradley Welling, M.D., Ph.D., FACS, the Walter Augustus LeCompte Chair of Otology and Laryngology at Harvard Medical School. “Dr. Edge is nationally and internationally renowned and will certainly continue to lead us to novel techniques to regenerate hearing. He is a world leader in this important field.”

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Boston Children's Hospital Develops iPad-based Audiogram Application

In 2012, Howard Shane, Ph.D., Director of the Center for Communication Enhancement and Brian Fligor, Sc.D., former Director of Diagnostic Audiology, approached the Technology and Innovation Development Office (TIDO) at Boston Children’s Hospital with an idea for the institution to develop their own electronic audiogram software that could be run on an iPad.

Over the course of a few years, their vision became a reality.

Audiologist Heather Saczynski, Au.D., collects audiogram data on an iPad.
Since its launch on December 1, 2014, “AudioHub” has alleviated technical problems identified with previous software by standardizing patient records (to better facilitate data sorting) and by preserving editing capabilities once a record has been submitted. In addition to simplifying workflow in the clinical setting, these details made the program more compatible for storing and using data for research.

Previously, audiologists at Children’s were using software licensed from an outside vendor, and the performance of that software left much to be desired.

From spreadsheet layouts that varied from patient to patient, making it nearly impossible to sort and analyze data, to an inability to correct mistakes once they’d been entered into the system, the audiology team was determined to build a program that would address the usability issues of their previous system and also take advantage of the portability of an iPad.

“The team had lots of ideas, and there was an opportunity to build something to really support our patients and our research needs,” said Derek Stiles, Ph.D., CCC-A, who was recruited as Director of the Diagnostic Audiology Program in 2014 (his predecessor, Fligor, had left Children’s to pursue a new opportunity). “Our previous system tried to do it, but it just wasn’t designed to meet our needs.”

The team was awarded a $93,000 grant from TIDO in 2013, which included matching funds from the Department of Otolaryngology and Communication Enhancement. They hired computer programmer Ashok Kumar to develop the software, working closely with the Children’s team, which included Fligor, Dr. Stiles, Dr. Shane and Tamar Gomes, Au.D., of the Waltham site and IT specialist Joseph Resendes.

“From a clinical perspective, AudioHub looks very similar to the traditional audiogram,” Dr. Stiles said. “But from a research perspective, it’s an invaluable data collection tool, and I think it will ultimately help us generate new knowledge on hearing loss.”

In AudioHub, the audiologist records information about the patient’s history, the results of relevant audiologic assessments, including tympanometry, pure tone thresholds, speech perception and auditory brainstem response testing, and recommendations for follow-up. Data about the patient’s hearing aid or cochlear implant can also be recorded in the application. There are multiple image fields that allow the audiologist to take advantage of the iPad’s camera to record visual data.

“The image fields provide a great deal of flexibility in AudioHub,” Dr. Stiles said. “If a patient shows up with a broken hearing aid, we can take a picture to be stored in the medical record. It really allows the audiologist to document important information in a way that a standard audiology form cannot.”

Once the audiologist submits information to a patient’s chart, that data becomes accessible in a few locations: an oracle database for research, Children’s 360 (the hospital’s central data warehouse) and AudGenDB, an NIH-funded multi-center database, led by researchers at the Children’s Hospital of Philadelphia. AudGenDB is a valuable tool for researchers across the country exploring pediatric hearing loss.

Because the application was developed for the iPad, clinicians are able to access other “apps” easily. For example, audiologists at Children’s have been using an educational tool showing the anatomy of the ear in conjunction with AudioHub. Clinicians may occasionally sit with patients and show them the results of hearing tests, and then switch over to the application with pictures of the anatomy of the ear, allowing them to better explain their condition.

“We can use these other applications to support our counseling of patients with hearing loss,” Dr. Stiles said. “I think the platform has enriched our communication with patients and their families.”

As an organization with five clinical sites offering audiology services, the Children’s team made designing an interface to service multiple locations a primary goal in the development of AudioHub. They also speculate that the flexibility of the program, along with the portability of the iPad, may translate well to other clinical environments.

“I think the program may be ideal, for instance, for a school audiologist who has to go from school to school for hearing screenings.” Dr. Stiles said. “It’s a nice, portable way to record the data and have it handy.”

“At a small practice that just needs it for day-to-day charting to a multi-center practice, I think it can be applied to just about anywhere.”

—Derek Stiles, Ph.D., CCC-A
Anyone who is working in our field knows that tinnitus has been this longstanding problem," said Dr. Melcher, an associate scientist who uses imaging to uncover physiological differences in the brains of humans with tinnitus. "It’s hard for clinicians to face the tinnitus patient, because they just don’t know what they can do to help them. It’s been a problem for decades."

"Tinnitus is a huge unmet medical need that affects millions of people," said D. Bradley Welling, M.D., Ph.D., FACS, the Walter Augustus LeCompte Professor and Chair of Otology and Laryngology at Harvard Medical School. "Thanks to the generosity of the Lauers, Mass. Eye and Ear is poised to make great progress in finding new treatments."

To understand tinnitus, researchers must study both the ear and the brain. The condition has long been associated with hearing damage, but in recent years, it has been shown that it can also arise from muscular or nerve damage in the face, neck or shoulder.

Scientists hypothesize that loss of neuronal activity, from either auditory or non-auditory...
centers, can result in a readjustment in the neural circuits that mediate hearing. When the brain does not receive adequate sensory input, it may compensate by amplifying the signals it receives. In some situations, this readjustment may lead to the perception of sounds when no sounds are present.

“Cracking the code of tinnitus requires expertise in the ear, where tinnitus arises, and the brain, where it ultimately resides,” said Dr. Liberman, Director of the Eaton–Peabody Laboratories. “There is no better place than Mass. Eye and Ear to merge this ear-brain expertise."

The Lauer family’s support furthers several active research projects that the team is currently working on. From studies in animal models to imaging the human brain using functional MRI imaging. Researchers in the Lauer Tinnitus Research Center are pursuing the following strategies in humans, researchers are pursuing multiple avenues to study tinnitus.

"Thanks to the Lauer’s extraordinary investment, we will apply imaging technologies in patient and animal models to ‘see’ tinnitus-related neural activity in a way we never could before," Dr. Liberman said.

While many treatments for tinnitus have been proposed in the literature, very few have undergone rigorous scientific investigation. A major goal of the Center is to develop clinical research studies for tinnitus that produce reliable data and definitively elucidate which treatments actually do help and which do not.

"Many of the studies out there draw conclusions from small sample sizes, and many of them fail to fully characterize the heterogeneous population they’re working with,” Dr. Melcher said.

In addition to basic science investigations, the Lauer Center will test potential treatment strategies using knowledge gained from the work of Dr. Melcher, who in 2000 was the first to demonstrate tinnitus-related hyperactivity in the human brain using functional MRI imaging. Dr. Melcher has since identified quantitative physiological differences between tinnitus sufferers and those without tinnitus that may be used to design research studies.

"We have been painstakingly meticulous in our comparisons within this heterogeneous group; it is the only way you can see the effects," Dr. Melcher said. “Because of our work, we have quantitative physiological indicators, such as the auditory brainstem response, that we can incorporate into clinical trials.”

While Mass. Eye and Ear does not have any immediate clinical solutions to offer tinnitus patients, the establishment of the Lauer Tinnitus Research Center represents a monumental opportunity to advance research and pursue reliable treatment strategies for this vexing condition.

“We really want to become a place where you can trust what you are told about tinnitus,” Dr. Melcher said. “We’re committed to finding out which treatments honestly work and which do not." ●

To further accelerate progress in the Lauer Tinnitus Research Center, Mass. Eye and Ear plans to recruit additional scientists, acquire new equipment and much more. If you would like to explore how you can help, please contact the Development Office at 617-573-3345.

Research Approaches

Researchers in the Lauer Tinnitus Research Center are pursuing the following strategies to study tinnitus in the ear and the brain:

Hidden Hearing Loss and Tinnitus
Dr. Charles Liberman, along with his colleague Dr. Sharon Kujawa, discovered in 2009 that even brief exposure to loud noise can result in permanent loss of auditory nerve fibers. They named this condition “hidden hearing loss,” because it does not affect the audiogram. However, it likely causes difficulty understanding speech in noisy environments and may well hold the key to the generation of tinnitus. Dr. Liberman and his colleagues are working on therapeutic approaches to regrow these sensory neurons in hopes of restoring hearing function and alleviating tinnitus.

Imaging the Inner Ear in Tinnitus
Dr. Konstantina Stankovic is pioneering the development of a new technology to non-invasively image the tiny sensory cells of the human inner ear. Because the inner ear is encased in the hardest bone in the body, no current imaging techniques can “see” the cells and neurons of the ear. Her research aims to develop an endoscope to be used in the exam room to assess neuronal survival in the inner ear, a key to diagnosing the cause of tinnitus.

Animal Models of Tinnitus in the Brain
Dr. Daniel Polley is a leading expert in the function of the auditory cortex and its ability to remodel and restore function after damage. He will develop a mouse model of tinnitus and, using the most powerful imaging tools available, assess the patterns of neural activity in the auditory cortex of behaving mice. His research will test basic hypotheses about the neural basis for tinnitus, which will help identify the appropriate cellular targets for pharmaceutical treatments.

Testing Tinnitus Strategies in Humans
In 2000, Dr. Jennifer Melcher was the first to demonstrate tinnitus-related hyperactivity in the human brain using functional MRI imaging (fMRI). An expert in this technique, she will use fMRI to scientifically test the efficacy of potential strategies for tinnitus. Her first targets will be to investigate the efficacy of hearing aids and bite guards to alleviate tinnitus. Her research will provide evidence-based knowledge to physicians and patients and help to offer near-term treatment options for some patients.
Kevin S. Emerick, M.D., and Daniel G. Deschler, M.D., first began to consider the application of the supraclavicular artery flap to head and neck reconstruction after a compelling presentation given by an international colleague, Claudio Cernea, M.D., of Brazil, at the annual meeting of the American Head and Neck Society.

“I came home and really wanted to read more about it,” Dr. Emerick said. “And I soon realized that it may be a good reconstructive option to have available for some of our patients.”

In addition to the work of international colleagues who had brought the supraclavicular flap into their armamentarium of reconstructive options, Drs. Emerick and Deschler were inspired by the work of Ernest S. Chiu, M.D., in New York, who applied the supraclavicular flap to head and neck reconstruction in New Orleans during Hurricane Katrina. In a time and geographical region when medical resources were scarce, the supraclavicular artery flap allowed Dr. Chiu another option when the resources needed for free flaps were not available.

As a type of pedicled flap, the supraclavicular artery flap is a reconstruction that does not require microvascular expertise and resources, making it more accessible to the greater population of head and neck cancer patients. It does not require a microscope in the operating room, nor does it require specialized monitoring.

When he first began to consider applying the supraclavicular artery flap to head and neck reconstruction, Dr. Emerick thought mostly of his aging population of patients, who may benefit from a surgery that puts a reduced amount of stress on their bodies.

“We’re operating on more 80-year-olds, 90-year-olds, transplant patients and those with major medical problems every year,” he said. “One of my driving forces has been to find a way to decrease the complexity of their surgeries without compromising functional outcomes.”

But with limited literature available, incorporating an entirely new technique into a busy head and neck
oncology practice presented a few challenges.

“It prompted us to think about, ‘how do you go about learning something new?’” Dr. Deschler said. “We took a very premeditated approach by reviewing the literature, talking to other surgeons with experience doing it, looking at anatomic studies in cadavers and with the patients we were operating on for other reasons.”

“Every time I did a neck dissection, I’d look down at those vessels and see where the pedicle might be,” Dr. Emerick said. “Ultimately, I just got progressively more comfortable, and I began to seek candidates where I had a dependable backup plan in case it didn’t work out.”

In July 2012, Dr. Emerick performed his first supraclavicular artery flap reconstruction on a cardiac transplant patient with a large skin defect on his cheek. In addition to wanting to offer a less complex surgery, Dr. Emerick believed that the supraclavicular artery flap, which utilizes tissue from the shoulder region, would offer the patient a better cosmetic result, because the skin color match is better than that of transferring free tissue from the forearm or thigh.

After a promising first outcome, Dr. Emerick shared his experience with Dr. Deschler and the rest of the Head and Neck Oncology Division at Mass. Eye and Ear. The two began to work together to implement the supraclavicular artery flap into their range of options for head and neck reconstruction.

“We started to identify more cases, and anytime one of us had a case, the other would step into the OR briefly to look at the vessels and the flap,” Dr. Emerick said.

As they worked together to bring this new technique into their already busy practice, they began publishing papers to share their experience with others in the field.

“We have spent our careers making sure that there is nothing out there that we do not do because we do not know how,” Dr. Deschler said. “As we developed a nice experience with this, we wanted to document what we were doing to create a framework for other surgeons to do it in a dependable, safe manner.”

While the supraclavicular flap has turned out to be a good reconstructive option for some of their patients, Drs. Emerick and Deschler emphasize that they do not consider the technique to replace the free flap and other reconstructions in their practice.

“It is not the ‘be all end all’ flap, and there are times when it is not the best reconstructive option available to a particular patient,” Dr. Emerick said. “Our Division is still doing around 100 free flaps per year — we’ve just added in doing 25 or 30 of these supraclavicular artery flaps per year in appropriate patients.”

“The more reconstructive options you can offer, the better you are able to help your patient at that time.” —Dr. Deschler

“By documenting their experience, they have contributed a wealth of what they’ve learned to the otolaryngology literature. They have published a series on using the flap after specific surgeries, another on details of surgical techniques they’ve refined in elevation and obtaining the tissue, as well as an assessment showing that shoulder function is not compromised after surgery.

In a forthcoming paper, they explore why the supraclavicular flap reduces overall complexity—assessing operative times, resource utilization, charge data, postoperative management and a variety of other factors showing that supraclavicular artery flaps generally require fewer resources than other reconstructive options.

“In the big picture of medicine, we have this huge push to diminish complications, to diminish hospital stay, to decrease morbidity,” Dr. Emerick said. “And I think in the right situations, this flap has the potential to do all of those things.”

“We’ve not in any way been willing to compromise on the quality of our reconstruction,” Dr. Emerick said. “The supraclavicular artery flap cannot replace free flaps in certain situations, but it can replace them in some very specific situations.”

As they continue to build volume and add to their experience with the supraclavicular artery flap, Drs. Emerick and Deschler remain connected with those colleagues they learned from initially, committed to sharing their experiences with the broader otolaryngology community.

“There’s been a real growth in our head and neck society and our relationships with the national and international head and neck oncologist community,” Dr. Deschler said. “And that is what these publications seek to do — to show key steps of how we do it for specific clinical problems, what the decision making process is — and to share what we have learned with our colleagues in the community.”

—Dr. Deschler
A t the 2012 Black Hills Powwow held in Rapid City, South Dakota, Sunshine Dwojak, M.D., M.P.H., screened local American Indians for head and neck cancer and collected more than 100 knowledge surveys as part of her resident research project designed to understand the underlying causes of poor survival rates in this population.

Her interactions that day offered deeper insight into the troubling health outcomes that have plagued the community.

“I met a woman who had a very large jaw mass, and I immediately encouraged her to see a doctor for treatment,” Dr. Dwojak said. “She said that she had been seen and had given up waiting for approval to see a specialist.”

A member of the Delaware Tribe of Indians and a descendent of the Rosebud Sioux Tribe, with family living on reservations in South Dakota, Dr. Dwojak has always had an interest in American Indian healthcare. During medical school at Harvard, she mentored American Indian undergraduates, volunteered at tribal clinics in southern California and helped organize a symposium on issues faced in American Indian healthcare.

Now a chief resident in otolaryngology at Mass. Eye and Ear/Harvard Medical School, Dr. Dwojak has spent her dedicated research time, supported by a T32 grant from the National Institutes of Health and with guidance from her mentors, Drs. Kevin Emerick and Daniel Deschler, investigating survival disparities in American Indians with head and neck cancer. The population is known to suffer poorer health outcomes in all areas of medicine, but especially related to cancer.

“Over the last 10 years, all Americans have shown improved survival in all types of cancer, mostly due to our improvements in treatment” Dr. Dwojak said. “But for American Indians, this has not been the case. Cancer outcomes have not improved at all in this particular population.”
She began by scouring the available data in the National Cancer Institute’s Surveillance, Epidemiology and End Results (SEER) database and showed in her first paper published on the project that head and neck cancer survival rates were lower in the American Indian/Alaska Native population.

One troubling conclusion reached in her review of the data was that patients in this community often present with late-stage disease. Her focus, then, shifted to knowledge assessments in the community.

“I wanted to determine whether or not there is a lack of awareness of risk factors and certain signs and symptoms,” she said. “Then, could we educate people and improve early stage detection in the community?”

To get a closer look at the problem, Dr. Dwojak began a collaborative relationship with Daniel Petereit, M.D., a radiation oncologist and founder of a local research group in South Dakota funded by the National Cancer Institute, “Walking Forward.” She made frequent trips to the John T. Vucurevich Cancer Care Institute in Rapid City to meet with local healthcare providers, to access charts and tumor registries and to attend community health events — including the Black Hills Powwow in 2012.

Following a series of chart reviews and knowledge assessments obtained by surveying the local American Indian population in South Dakota, Dr. Dwojak published a second paper that demonstrated some gaps in American Indian knowledge of head and neck cancer risk factors and symptoms, with the suggestion that community-based head and neck cancer screenings may be a worthwhile intervention.

But she admits that she learned more about the situation through her experiences “on the ground” in South Dakota than she was able to show in the literature. She speculates that there are primarily economic barriers limiting access to cancer care specialists, and that this is a contributing factor to the problem of many in the population presenting with late-stage disease.

“I have learned that it is much more complex than knowledge deficits and smoking and drinking histories,” she said. “I firmly believe that there is a barrier in getting referred out of the system, and that it often prevents people from getting treatment for early-stage problems.”

While the economics of healthcare in the American Indian/Alaska Native community are complicated and vary from tribe to tribe, services are generally provided by the Indian Health Services (IHS) through the United States government. If patients present with conditions that require treatment beyond the scope of what the IHS can provide, their cases must be presented to a review board for referrals outside the system, known as “contract health services.” Priority is often given to those with more immediate needs.

“In places as remote as South Dakota, much of the contract health services budget gets eaten up by air flights for trauma,” Dr. Dwojak said. “As you can imagine, if someone has suffered trauma or needs a heart transplant, they will probably go ahead of someone who has a lump in their jaw.”

In a third paper that expanded upon risk factors contributing to poor survival for American Indians with head and neck cancer, Dr. Dwojak explored one piece of the limited access problem by showing the great distances some patients must travel to reach one of the two cancer centers in South Dakota, with 81% living more than a one-hour drive away.

With a better understanding of the variety of factors contributing to poor survival rates, Dr. Dwojak hopes to design interventions aimed at improving access for American Indians to receive preventative care, screening services and cancer treatment. This may include taking advantage of virtual medicine technologies and funding mechanisms to connect patients in remote areas with highly specialized physicians around the country.

“It’s possible that we could use telemedicine in some situations, to counteract the lack of doctors in remote areas,” she said. “We could have someone over there with a laryngoscope, and if there’s something concerning, specialists can help make the case for referring them out of the system.”

Nearing her graduation from residency in June, Dr. Dwojak will pursue fellowship training in head and neck cancer/microvascular surgery at Vanderbilt in July. Without getting too far ahead of herself, she hopes to continue this research in the future and work toward sustainable solutions.

“My long-term goal is to find sustainable solutions through networking with others in the community,” she said. “We need to tackle the issues that are causing those who need specialized care to be trapped in the system.”
A little more than 30 years ago, John F. Anderson, Jr., underwent a surgery that changed his life and would impact the lives of future generations of deaf patients.

As a research subject working with Donald K. Eddington, Ph.D., who pioneered one of the first multichannel cochlear implants, the Ineraid system, Anderson became the first cochlear implant recipient in the New England area in December of 1984.
Anderson recalls the powerful moment in June of 1985, when his device was first activated.

“There were many people there to witness the event—I did my best to ignore them,” he said. “When Don turned on the processor, it was like he was turning on a faucet, and I just started hearing again.”

The Ineraid Cochlear Implant System

Dr. Eddington was recruited to Massachusetts Eye and Ear as a postdoctoral fellow in 1977, to continue the work he began as part of his doctoral dissertation at the University of Utah, developing technology that would later be applied to the Ineraid cochlear implant system. He made frequent trips to Utah to continue his collaboration with early cochlear implant subjects there.

“At the time, it was just an implant without a sound processor,” he said. “These earliest subjects volunteered with the understanding that they probably would only hear in the laboratory as we gathered the information needed to design a sound processor that may benefit future generations.”

He returned to Mass. Eye and Ear in 1983 to begin a more permanent role as Founding Director of the Cochlear Implant Research Laboratory (CIRL) and faculty member of the Department of Otology and Laryngology at Harvard Medical School. He served as Director of CIRL up until his retirement in 2013, contributing to the development and implementation of the cochlear implant program at Mass. Eye and Ear along the way.

The Ineraid was one of four major multichannel processors developed in the 1980s. The other three designs were spearheaded by Graeme Clark, M.D., Ph.D., of the Royal Victorian Eye and Ear Hospital in Australia, Robin Michelson, M.D., and Michael Merzenich, Ph.D., of the University of California at San Francisco, and Professors Erwin and Ingeborg Hochmair, of the Technical University of Vienna in Austria.

Though the four designs were similar in many ways, one aspect that set the Ineraid apart from the others was the use of a connector through the skin instead of radio telementry and implanted electronics to deliver electric stimuli to the implanted electrodes. Though not commercially available today like the others, the direct connection of the Ineraid turned out to be an advantageous feature in the laboratory.

In 1983, Dr. Eddington’s design caught the attention of Symbion, Inc., who manufactured the Ineraid device and its first sound processor, and Mass. Eye and Ear began its first clinical trial for cochlear implants.

Three Years of Silence

Born with one deaf ear and with progressive hearing loss in the other, Anderson became completely deaf in August of 1982. At that time, he had been attending support group meetings sponsored by the Audiology Department at Mass. Eye and Ear. Knowing how Dr. Eddington’s work was progressing, an audiologist named Julie Rubin promised Anderson that she would keep him apprised of any clinical trials for cochlear implants.

As a computer programmer, he was able to get by in his professional life with lip reading and telecommunication technology to assist him. But adjusting to life without any sound information at all presented new challenges.

“My personal life became quite turbulent as I tried a number of different things to try to reconfigure my life now that I was without sound,” Anderson said.

He took American Sign Language classes, began working with a hearing dog, went to counseling and became further involved in the deaf community.

“These were all experiments, and none of them really worked for me,” he said. “The three years that I was deaf were the most difficult years of my life.”

Continued on page 14
Returning to the Hearing World

In the spring of 1984, Julie Rubin contacted Anderson with some good news.

“Dr. Eddington was looking for research subjects and wanted me to come in for an interview,” he said. “After our meeting, it seemed like I’d be a good first subject for the trial.”

Following a series of preliminary assessments, including a promontory simulation procedure with his surgeon, Joseph B. Nadol, Jr., M.D., (to verify that the auditory nerve was functional) and evaluations by a psychiatrist and psychologist, Anderson’s surgery was scheduled for December of 1984.

“I had nothing to lose and was very excited to give it a try,” he said. “The procedure had been done numerous times in Utah, where Dr. Eddington was from originally, and Dr. Nadol was a highly experienced surgeon.”

Anderson’s participation as the first cochlear implant subject at Mass. Eye and Ear was a brave gesture in a time when cochlear implants were very new to the medical community.

“A few other people had gotten devices around the country, but this was experimental,” said Barbara Herrmann, Ph.D., an audiologist and researcher at Mass. Eye and Ear who collaborated with Dr. Eddington when Anderson was a subject. “He was very courageous.”

Contributing to Cochlear Implant Research

Following cochlear implant surgery, Anderson—and other Ineraid research subjects who joined him soon after his surgery—received follow-up care and testing from Dr. Eddington and other members of CIRL. The subjects came in twice a month for several years to do experimental sessions.

“They were a very dedicated group,” Dr. Herrmann said, of the subjects. “Many of them still come in today and are happy to give back.”

The unique design of the Ineraid offered an ideal setting for research opportunities, because the electronics are all on the outside of the body. The connector travels through the skin, providing direct access to the implanted electrodes. The Ineraid subjects became a valuable resource for Dr. Eddington and colleagues in the community, as they tried to determine better ways of processing sound through the cochlear implant.

“We were trying to understand how to better use the electric stimuli that are delivered to the electrodes,” Dr. Eddington said. “The participation of these early subjects in the research effort was very important in the development of the newer sound processing schemes.”

Continuous interleaved sampling (CIS) processing, the strategy most widely used today, was initially tested and implemented through research on the Ineraid subjects.

Initially suggested by Dr. Eddington and CIRL, the CIS strategy was later developed by Blake S. Wilson, of Duke University, and commercialized by MED-EL. In 1995, Ineraid subjects received a sound processor that implemented CIS processing for the Ineraid, to allow them to benefit from the new technology that was developed based upon their participation in experiments.

Hearing with the Ineraid

With the Ineraid’s help, Anderson recovered some of his hearing.

“When I first began to hear again, it felt as though I was once again able to share sounds with those who can hear,” he said. “It was thrilling to hear the chatter of birds, music sounded wonderful and even road noise sounded good at first.”
“I began to feel like things might start becoming easier now that I was hearing some sound once again,” he said.

In the late 1990s, Anderson began to explore a career change to counseling, with the thought that he may be able to eventually help other deaf patients and families adjust to life with hearing loss.

“I worked with a career change counselor, and what consistently came up in our conversations was that I was a good listener,” he said.

“So, I began to consider counseling as a career.”

He earned his Master’s of Applied Psychology from Antioch University New England in Keene, New Hampshire. In his second year of graduate school, he completed an internship at the Clarke School for Hearing and Speech. The school was in the process of creating a new Mainstream Center, and Anderson was offered a job after graduation as Mainstream Adjustment Counselor at the Center.

“My years at Clarke were challenging, because it was an entirely new role,” he said. “I was able to do some counseling, and I gave workshops in multiple countries under the theme of adjustment to hearing loss.”

While working at the Clarke School, Anderson authored a children’s book for parents, teachers and children growing up with hearing loss. Published in 2004, My Hearing Loss and Me reflects on Anderson’s own experience of growing up with hearing loss, and what he learned in his first seven years of counseling students with hearing loss.

“My hope for the book was that it would show how important it is to support a child with hearing loss in the mainstream at school and at home,” Anderson said. “I tried to highlight the difficulties of keeping up with communication in a variety of situations.”

Though he accomplished quite a lot in his time at the Clarke School, Anderson’s role was eliminated in 2009 due to a lack of funding. Shortly after, he and his wife, Katherine Thurmond, moved from the Boston area to California to be closer to family.

He returns to Boston to visit Dr. Herrmann and a few other familiar faces at Mass. Eye and Ear occasionally to have his Ineraid serviced. Because the Ineraid system is no longer manufactured, it cannot be maintained by other cochlear implant clinics across the country. Mass. Eye and Ear continues to provide care for the remaining Ineraid patients — using a shrinking inventory of parts — as a humanitarian service.

“It’s the least we could do for individuals who gave quite a lot,” Dr. Herrmann said.

Even after 30 years, Anderson reports that he continues to do very well with his Ineraid, which has required very few repairs over the years.

“The quality of the workmanship and the design of this device is outstanding,” he said. “Over the course of 30 years, I have only had repairs done four to eight times, and almost all those repairs were to my ear hook assembly.”

No longer an experimental medical procedure, cochlear implantation has become increasingly accessible to patients with hearing loss around the world. The Otology Service at Mass. Eye and Ear performs approximately 100–120 cochlear implant surgeries per year.

“It has dramatically changed the face of deafness, because there is no longer a point at which there is nothing that can be done if a person loses their hearing,” Dr. Herrmann said. “Over the past 50 years, the number of people who now have access to the technology has dramatically grown, and we’re now implanting with less and less hearing loss.”

She acknowledges the important role of Anderson and other cochlear implant research subjects in the development of this successful intervention for hearing loss.

“No matter how many brilliant scientists you have, if you don’t have courageous people to take that first step, medical breakthroughs are impossible.”

Anderson and his wife, Katherine Thurmond.
Cochlear implants have restored hearing for more than 350,000 people, and that number continues to grow, as clinicians and engineers around the world are working toward improving the technology further.

In light of a recent collaboration between Konstantina Stankovic, M.D., Ph.D., FACS, an otologic surgeon and researcher at Mass. Eye and Ear/Harvard Medical School, and Anantha Chandrakasan, Ph.D., Head of Electrical Engineering and Computer Science at MIT, the implant’s bulky exterior unit, which raises concerns in some individuals with social stigma and has limited use in the shower and during water sports, may soon no longer be necessary.

With a team of researchers, including then-graduate students Marcus Yip and Rui Jin, as well as Heidi Nakajima, M.D., Ph.D., they have developed a prototype system-on-chip that makes possible a fully implantable cochlear implant. The system-on-chip electrically stimulates the auditory nerve in a similar fashion to the conventional cochlear implant, with one important difference.

Where conventional cochlear implants are made up of an external unit with a microphone and sound processor to transmit information to implanted electrodes, the system that Drs. Stankovic and Chandrakasan developed relies on a piezoelectric sensor — implanted beyond the ear drum in the middle ear — to transmit sound information by picking up on vibrations from the hearing bones.

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Dr. Konstantina Stankovic and her collaborator, Dr. Anantha Chandrakasan of MIT, demonstrate that the chip may be charged wirelessly using a smart phone.
“In a way, it is the body’s natural microphone,” Dr. Stankovic said. “When sound waves hit the eardrum, they set into motion the smallest bones in the body, and their vibration leads to the vibration of fluids in the inner ear, which stimulates sensory cells and the auditory nerve, thus completing conversion from mechanical vibrations into electrical impulses.

After pairing the system-on-chip with the piezoelectric sensor, which was already developed for the middle ear implant and readily available “off the shelf,” Drs. Stankovic and colleagues tested the device on a human cadaver. Results have been very encouraging.

“The micromechanics of how these little bones vibrate is very similar in cadavers and in live humans, so we were able to study the output of our system,” Dr. Stankovic said. “It seems very comparable to the existing cochlear implant.”

With Dr. Chandrakasan, a renowned expert in ultra low-power electronics, the team is working to optimize the power supply of their device. The chip is specially designed to be charged wirelessly through a smartphone while the user is making a phone call. They have shown that it takes just a few moments to charge and that the charge lasts for 8 hours.

“It is a requirement that anything fully implanted in the body must be low power,” Dr. Stankovic said. “We’re looking into every opportunity to make the device more energy efficient.”

Dr. Stankovic speculates that they may eventually be able to harness energy from the user’s own body to power the implant. In 2012, the same team working on the system-on-chip found that they could extract energy from the inner ear to function like a “biological battery.” But the energy extracted from the inner ear turned out to be insufficient to power a cochlear implant.

“Others are exploring this further, because the body is a huge reservoir of energy,” Dr. Stankovic said. “At some point, that may become practical.”

Now that the team has demonstrated feasibility of the system-on-chip paired with a sensor and wireless power supply, they are working to fully package the device and prepare for a clinical trial.

“We have a little more work to do to have a fully assembled, packaged device that can be surgically implanted,” Dr. Stankovic said. “The next step would be a clinical trial, and we need to show that its performance is at least as successful as the existing devices with the additional advantage of not having external components.”

Dr. Stankovic is eager to study through clinical trial a potential functional benefit that they’ve not yet had the opportunity to test. The fully implanted cochlear implant may offer improved sound localization.

“It turns out that the outer ear and the ear canal are important in filtering sounds,” she said. “So if you have a microphone that’s sitting next to the ear, you lose all of those directional cues. But with our system, where the sensor is on the other side of the eardrum, you still maintain all of those directional cues.”

Dr. Stankovic, who tackles otologic conditions through a variety of approaches in her research, is excited about the potential of this future direction for the cochlear implant, a therapeutic approach she's been working on for many years. Dr. Stankovic began working at Mass. Eye and Ear in the early 1990s as an undergraduate student at MIT, working on her physics thesis in the cochlear implant research laboratory. The fully implantable cochlear implant project is the latest step in a mission that hits close for Dr. Stankovic.

“It’s very near and dear to my heart,” she said, of the project. “Cochlear implants are the reason I’m in the auditory field today.”
As he progressed through residency, he developed a passion for neurotologic surgery. “I realized that I loved microsurgery and working in the ear,” he said. “In part, because you can do so much good for somebody with these delicate surgical procedures, and because I loved practicing in the temporal bone lab.”

Dr. Megerian recalls spending his research hours with Michael J. McKenna, M.D., Joseph B. Nadol, Jr., M.D., and Harold F. Schuknecht, M.D., in the temporal bone lab at Mass. Eye and Ear, and he credits two projects with setting him on a successful academic career trajectory.

One research project involved a poorly understood tumor known to destroy the middle ear and sometimes lead to death, then-known as the aggressive middle ear papillary tumor. Dr. Schuknecht, working with pathologist Dennis Heffner, M.D., believed that the tumors originated in the endolymphatic sac and sought Dr. Megerian’s help in proving the theory.

Through a case review in the temporal bone collection, the team provided necessary evidence to prove that the tumors originated in the endolymphatic sac, helping to initiate a change in nomenclature to “endolymphatic sac tumors” in the otolaryngology literature. “I was sort of the lead sled dog on that project,” he said. “Later in my career, I was able to create a surgical technique to remove these tumors and preserve hearing, and I became further interested in Ménière’s disease.”

Dr. Megerian began a second project during his fellowship training studying Ménière’s disease in guinea pigs, to better understand the long-term effects of the condition, and especially why it often causes hearing loss. Building upon his work with the guinea pig model, he later developed a genetic mouse model for endolymphatic hydrops and Ménière’s disease, and he described the entire disease course in mice. The model has engendered progress in the field, contributing to our understanding of endolymphatic hydrops and the long-term effects of Ménière’s disease.

“I firmly believe that those two projects I began at Mass. Eye and Ear led to my success academically, allowing me to be promoted to an endowed professorship and allowing me to become chair of my department here at Case three years ago,” he said.
Dr. Megerian completed his fellowship training at Mass. Eye and Ear in 1995 and returned to Case Western Reserve University Hospital in 2002, following 7 years in academic practice at the University of Massachusetts Medical Center, where he began a cochlear implant program and developed an otology curriculum in the residency program for Boston University otolaryngology residents.

Initially hired as Director of Otology and Neurotology at Case Western in 2002, his impressive leadership and development of the division led to a promotion to Vice Chair of the Otolaryngology Department in 2008, and he eventually became Chair of the Department in 2012. In the three years since he became chair, Dr. Megerian has grown the faculty by seven clinicians and five basic scientists, and he has played a role in their philanthropic development, increasing the number of endowed chairs from one to five.

“My focus is on building a team of people who share the same commitment to excellent care, excellent outcomes,” he said. “We’ve also built a research program to include five scientists studying the inner ear—all of them NIH-funded—and I’m very proud knowing their accomplishments.”

In his new role as President and CMO of University Hospitals Health Systems, Dr. Megerian cited three major goals: 1) perfecting system integration, by facilitating seamless transitions for patients to go from primary care doctors to specialists to operating rooms, 2) improving healthcare delivery with the use of telemedicine and virtual health for more routine clinical scenarios and 3) maintaining the academic mission of physicians amid new challenges from the evolving American healthcare system.

The last goal, he admits, is the one that keeps him up at night the most.

“There are a tremendous amount of factors at play right now that are making all of us do more with less,” he said. “I have to find a way, with my colleagues around the United States, to maintain what has made American medicine so great over the years, and that is research, teaching and discovery. In spite of the mounting pressure to provide the best healthcare possible with fewer resources, we have to find ways to allow that to continue to flourish.”

With these administrative challenges and opportunities, Dr. Megerian often thinks of his mentors for examples of leadership.

“Using some of the lessons I’ve learned from leaders like Joe Nadol on how to manage a large organization and still have time to be clinically active in some way, to care about the people you work with and to be dedicated to the overall delivery of excellent patient care,” he said. “As long as I stick to those fundamentals, I should be okay.”

“I give because I am grateful for the training I received. It is important to me that the next generation of otolaryngology specialists has access to the very best teaching resources, like the incredible Joseph B. Nadol, Jr., M.D., Otolaryngology Surgical Training Laboratory.”

— Cliff Megerian, M.D., ’95
Introducing the HMS Otolaryngology Alumni Giving Society

The Department of Otolaryngology at Mass. Eye and Ear/Harvard Medical School is excited to announce the establishment of the Alumni Giving Society. The Alumni Giving Society recognizes faculty and alumni who make gifts of $1,000 or more with a one-year membership during the fiscal year (October 1 – September 30) with opportunity for renewal. Participation is a way to stay connected and to help deliver the finest teaching experience for today’s otolaryngology residents and fellows.

Our alumni know firsthand that support of the vital work of our students and faculty in the Department of Otolaryngology helps drive continued achievement across all areas of education, research and patient care. To date, we have 25 members whom we salute for their generosity and for partnering with us to achieve our department goals and institutional mission.

If you are not a member, please consider joining your colleagues today by making a gift with the enclosed envelope. As a member, you may designate your gift in the way that has the most meaning for you.

To learn more, please contact Julie Dutcher in the Development Office at 617-573-3350.

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Current Alumni Giving Society members for fiscal year 2015 as of April 1, 2015 are listed below. With your gift of $1,000 or more by September 30, 2015, you will be included in the 2015 Alumni Giving Society.

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Basic Science

Scientists restore hearing in noise-deafened mice, pointing way to new therapies

Five years ago, research colleagues M. Charles Liberman, Ph.D., and Sharon G. Kujawa, Ph.D., first described “hidden hearing loss,” in which noise exposure damages not only the inner ear sensory cells, but also the nerve fibers connecting those cells from the ear to the brain. This hearing loss often does not show on an audiogram, but it may lead to difficulty hearing in noisy environments.

Building upon this discovery, Dr. Liberman and researchers from the University of Michigan Medical School’s Kresge Hearing Research Institute reached another important breakthrough in this line of research. In the online journal eLife, they demonstrate the importance of a key protein (NT3) responsible for maintaining these nerve fiber connections and have restored hearing in noise-deafened mice using advanced tools to boost the production of this key protein in the ear.


Non-canonical pathway from cochlea to brain signals tissue-damaging noise

A team of researchers, including Dr. Liberman, published a paper showing that the unmyelinated fibers in the cochlear nerve, whose function has remained unknown, respond to hair cell damage in the inner ear and thus likely constitute the nociceptive pathway of the auditory periphery responsible for signaling auditory pain. This discovery could help lead to the development of therapies for hyperacusis, the debilitating hypersensitivity to moderate level sounds that sometimes occurs following acoustic injury.


New system could be used to treat deafness, other genetic conditions

A team of researchers including Zheng-Yi Chen, Ph.D., developed a system that uses commercially available molecules, cationic lipids, to efficiently deliver genome-editing proteins into cells, and have even demonstrated that the technology can be used to perform genome editing in living animals.

They believe that delivering genome-editing proteins into cells could offer hope to patients suffering from a host of conditions, including certain diseases of the eye, ear, liver, muscles and blood. Dr. Chen’s team will use the newly developed system to modify genes in specialized hair cells in the inner ears of mice to pursue new protein-based therapies for hearing loss.


Researchers find salicylates, a class of NSAIDs, stop growth of vestibular schwannomas

A team of researchers including Konstantina Stankovic, M.D., Ph.D., FACS, demonstrated that salicylates, a class of non-steroidal inflammatory drugs (NSAIDs), reduced the proliferation and viability of cultured vestibular schwannoma cells that cause a sometimes-lethal intracranial tumor that typically causes hearing loss and tinnitus.


P-glycoprotein inhibitor may lead to new therapies for chronic rhinosinusitis with nasal polyps

Chronic rhinosinusitis with nasal polyps is a lifelong inflammatory disease of the sinuses. The causes of this disease are poorly understood and, consequently, treatment options are limited to steroids, which have many negative side effects. Benjamin S. Bleier, M.D., and members of his laboratory have discovered that a cellular pump, P-glycoprotein, is overactive in these patients and may be responsible for the high levels of inflammation seen in these patients. Dr. Bleier demonstrated that Verapamil, an inhibitor of P-glycoprotein, can block the release of some of the cytokines specifically involved in polyph-related inflammation. These results not only point the way toward a better understanding of what causes chronic rhinosinusitis with nasal polyps, but they also open the door to new therapeutic options.


Researchers demonstrate functionality of key component in the development of an implantable inner ear drug delivery device

A team of researchers from Draper Laboratory continues their collaboration with faculty at Mass. Eye and Ear, including Sharon G. Kujawa, Ph.D., Michael J. McKenna, M.D., and William Sewell, Ph.D., to develop an implantable drug delivery device for the treatment of sensorineural hearing loss. The device addresses one of the most significant challenges in restoring hearing.

Zheng-Yi Chen, Ph.D., with research fellows in his laboratory.
Light-based activation of the auditory system

Elliott D. Kozin, M.D., A. Ed Hight, M.S., M. Christian Brown, Ph.D., Daniel J. Lee, M.D., and colleagues from MIT have demonstrated the ability to stimulate the auditory system with light. Currently, cochlear and auditory brainstem implants use electrical stimulation, which may lead to variable audiometric outcomes and side effects. In contrast, light may offer more specific stimulation. Their findings have been published in a recent special issue on the Lasker Award for the cochlear implant in the journal Hearing Research.

Authors found in a murine auditory brainstem implant model that the central auditory pathway could be sensitized to light by delivery of novel light sensitive proteins called “opsins.” Prior reports by this group demonstrated that older generations of opsins may be too slow to encode speech information. However, a new opsin, developed by collaborators at MIT, called Chronos, may have the kinetics fast enough to form the basis of a light-based auditory implant. These findings have implications for the future of auditory neuroprosthetics, as well as improved outcomes in patients with cochlear and auditory brainstem implants.

Clinical Practice

Disparities in emergency department utilization for acute sinusitis

A team of rhinologists, including senior author Ahmad R. Sedaghat, M.D., Ph.D., recently published a series of assessments related to emergency department utilization for acute sinusitis.

In this study, researchers have shown that hundreds of thousands of individuals continue to utilize emergency departments annually for uncomplicated acute sinusitis — a non-urgent condition that can be appropriately managed in outpatient clinics — and also showed a correlation with Medicaid insurance. Though previous studies have suggested that individuals with Medicaid are less likely to be satisfied with the quality of their primary care encounters and have more difficulty getting access to clinic appointments in a timely manner, this study found that there were no disparities in quality of acute sinusitis primary care for patients with Medicaid. In fact, physicians were found to spend more time with Medicaid patients compared to patients with private insurance.

Psychophysics and prosthetics in the diagnosis and treatment of vestibular disorders

In a recent review paper, Richard Lewis, M.D., discussed a new diagnostic approach for vestibular disorders, psychophysical vestibular testing, suggesting that it may be superior to other methods of clinical vestibular testing in some situations. In the same paper, Dr. Lewis, reviews the potential therapeutic benefits of vestibular prosthetics, which may offer a way to provide the brain with information about head motion that restores some elements of the information normally provided by the vestibular labyrinth.

Symptom overlap between laryngopharyngeal reflux and glottis insufficiency in vocal fold atrophy patients

A team of researchers including Thomas L. Carroll, M.D., of Brigham and Women’s Hospital, recently published a study of throat clearing and mucus sensation symptoms in true vocal fold atrophy patients. Though they are typically attributed to laryngopharyngeal reflux, the authors determined that the symptoms may in fact be due to an underlying glottis insufficiency and changes of the aging larynx.

Endoscopic management of laryngeal clefts

Faculty from Boston Children’s Hospital, including Elam A. Adil, M.D., M.B.A., and Reza Rahbar, D.M.D., M.D., have recently described an endoscopic surgical technique for the treatment of type 3 laryngeal clefts, which are traditionally repaired through an open approach. This paper shows the outcomes of six patients who underwent endoscopic carbon dioxide laser-assisted repair for type 3 laryngeal clefts. The authors outline specific situations when this approach should be considered as an alternative to open repair.

Histopathology of balloon-dilation eustachian tuboplasty

Balloon eustachian tuboplasty is a new and evolving surgical therapy for treating dilatory eustachian tube dysfunction. Clinical results to date have shown an effective reduction in mucosal inflammation and long-term lasting benefits, which are surprising given the brief duration of the dilation.

A team of researchers including Dennis S. Poe, M.D., of Boston Children’s Hospital, examined histology from eustachian tubes before and after dilation demonstrating that the procedure strips off the irreversibly inflamed surface mucous membrane and crushes the inflammatory tissue in the submucosal tissue. There was some early evidence that the mucous membrane healed with new healthy tissue and the thick inflammation in the submucosa became replaced with thinner, healthy scar. These results offer evidence that re-growth of healthy eustachian tube tissue with lasting benefits may be possible with balloon dilation.


Correction of the alar base in patients with flaccid facial paralysis

Nasal valve collapse caused by facial palsy is an often overlooked but disturbing sequela of flaccid facial paralysis. From March 2009 to December 2013, faculty from the Facial Nerve Center at Mass. Eye and Ear, including Tessa A. Hadlock, M.D., and Robin W. Lindsay, M.D., prospectively studied the effect of placement of a fascia lata sling for correction of external nasal valve compromise in 68 patients with flaccid facial paralysis, utilizing a validated disease specific quality of life outcome survey, the Nasal Obstruction Symptom Evaluation (NOSE) scale. Ratings were ascertained preoperatively and postoperatively. Sixty patients completed a NOSE survey prior to surgical intervention and 40 completed the survey after intervention. There was a statistically significant difference in NOSE scores after fascia lata sling (Wilcoxin signed-rank test, p<0.001). All patients had improvement in their nasal obstruction, which persisted uniformly in follow-up.


Use of intraoperative CT scanning for maxillofacial reconstructive surgery

An important part of intraoperative decision making, intraoperative computed tomography (CT) provides surgeons with real-time feedback during maxillofacial trauma and reconstructive surgery. A team of researchers including David A. Shaye, M.D., recently published a study evaluating a variety of factors, including the time needed to perform intraoperative CT scans during maxillofacial surgery and to identify the characteristics of cases that required intraoperative revision based on the results of an intraoperative CT scan. In the study, which reviewed 38 cases, the authors concluded that current intraoperative CT scanning techniques are rapid, averaging 14.5 minutes per case, and that intraoperative revisions were most common in complex cases. They recommend that surgeons use intraoperative CT imaging for maxillofacial reconstruction, especially in complex procedures.


Outcomes in professional voice artists undergoing thyroidectomy

A team of researchers including Gregory W. Randolph, M.D., published a quantitative analysis of pre- and postoperative neural-monitored thyroid surgery voice outcomes in a unique series of professional singers/voice users. Utilizing three validated vocal instruments, the Voice Handicap Index (VHI), the Singing Voice Handicap Index (SVHI) and the Evaluation of Ability to Sing Easily (EASE), researchers surveyed the outcomes of 27 vocal professionals undergoing thyroidectomy with the assistance of nerve monitoring technology. They also studied objective outcome measures such as final intraoperative EMG amplitude, the time to return to performance and vocal parameters affected. The authors concluded that with nerve monitoring technology, thyroidectomy – including those for thyroid malignancy – is safe in professional voice users, showing that there were no changes in three different voice/singing instruments and that 100 percent returned to performance.

Ears and hearing effects continue to reverberate after Boston Marathon bombing

Study in the journal *Otology & Neurotology* shows continued follow up and care of this patient population is warranted

After two bombs exploded near the finish line of the Boston Marathon on April 15, 2013, acute trauma to the ears — such as ruptured eardrums — was immediately apparent to those caring for the victims. However, the full extent of the effect on the ears and hearing of victims was not fully recognized for weeks. In the end, more than 100 patients were evaluated for blast-related otologic injuries.

Almost immediately, Boston researchers set out to detail the types of otologic injury and report on the outcomes of patients undergoing treatment. Ninety-four of the injured individuals elected to enroll in an eight-institution study that began before the end of April 2013 through the efforts of Harvard Catalyst, the clinical and translational science center that facilitated a framework for Harvard Medical School-affiliated institutions to speed the review of human studies. The research findings were reported in the December 2014 issue of the journal *Otology & Neurotology*.

“The purpose of this report is to describe the burden of otologic injury following the Boston Marathon bombings and to understand how otologic trauma has affected patients’ quality of life,” said lead author Aaron K. Remenschneider, M.D., M.P.H., a clinical fellow in neurotology at Mass. Eye and Ear who was a chief resident at the time of the bombings and cared for many of the victims.

Using a multi-institutional, prospective cohort study, researchers from eight medical campuses evaluated children and adults seen for otologic complaints related to the Boston Marathon bombings. Participants completed an otologic/noise exposure history, a current symptom assessment and quality of life questionnaires at initial visits and six months later. Records from otologic evaluation and audiometry were reviewed.

“Of the 94 patients that enrolled, only seven percent had any otologic symptoms prior to the blasts,” said Alicia Quesnel, M.D., senior author and otologic surgeon at Mass. Eye and Ear and Harvard Medical School, who continues to provide care for these patients. “All patients evaluated reported hearing loss or tinnitus.”

Seventy-nine patients had initial audiograms available for review that revealed conductive, sensorineural or mixed hearing losses. Ninety percent of hospitalized patients suffered ruptured eardrums. Those who were closest to the blasts and who had other significant injuries also experienced ruptured eardrums. Twenty-one non-healing ear drum perforations were surgically repaired with closure of the perforation in all but two.

“Hearing, tinnitus and dizziness-related quality of life was found to be impaired in these patients,” Dr. Quesnel continued. “Our conclusion is that blast-related ear injuries constitute a major source of ongoing morbidity following the bombings. Patient symptoms continue to evolve and many patients have ‘hidden hearing loss,’ which may not be apparent on routine hearing tests. There is a definite need for long-term follow-up assessments to ensure that patients receive appropriate testing and treatment.”

The need for ongoing care for hearing-related issues was acknowledged in September 2014 when One Fund Boston, the charity created to accept and distribute donations to help those affected by the bombings, created the One Fund Center, which will serve patients who have had difficulties with tinnitus and other hearing-related problems; mental health issues, including post-traumatic stress disorder and anxiety; and traumatic brain injury and its associated symptoms such as headache, cognitive symptoms and balance difficulties. Hearing loss and tinnitus care, which will be coordinated through Mass. Eye and Ear, will involve a combination of medical evaluation, state-of-the-art hearing testing, pharmacologic intervention, acupuncture and stress management techniques.
New Faculty

Yukako Asai, Ph.D., was recently appointed Instructor of Otology and Laryngology at Harvard Medical School. Previously a postdoctoral fellow in the Department, Dr. Asai is a researcher based at Boston Children’s Hospital, working in the laboratory with Jeffrey R. Holt, Ph.D., and Gwen Géléoc, Ph.D., investigating the mechanisms of hair cell mechanotransduction.

Amy H. Hughes, M.D., will join the Department of Otolaryngology and Communication Enhancement at Boston Children’s Hospital in July with an appointment of Instructor of Otology and Laryngology at Harvard Medical School. Dr. Hughes earned her medical degree from the Stritch School of Medicine at Loyola University and completed her residency in otolaryngology at the University of Connecticut Health Center. She went on to pursue fellowship training in pediatric otolaryngology at Boston Children’s Hospital. Dr. Hughes returns to Children’s following a year practicing in Hartford, Conn.

Anne Hseu, M.D., will also join the Department of Otolaryngology and Communication Enhancement at Children’s in July as an Instructor of Otology and Laryngology at Harvard Medical School. Dr. Hseu received her medical degree from the Feinberg School of Medicine at Northwestern University in Chicago, Ill. She completed her residency training in otolaryngology at Cleveland Clinic and fellowship training in pediatric otolaryngology at Boston Children’s Hospital. She then pursued additional fellowship training in laryngology at Mass General. She returns to Children’s to begin a practice focusing on pediatric laryngology and voice disorders.

Allen Lam, M.D., will join Mass. Eye and Ear’s new Longwood practice in August as an Instructor of Otology and Laryngology at Harvard Medical School. Dr. Lam earned his medical degree at Case Western Reserve University School of Medicine in Cleveland, Ohio. He will practice general otolaryngology following the completion of his residency at Mass. Eye and Ear/Harvard Medical School.

Ahmad R. Sedaghat, M.D., Ph.D., will join the Rhinology Division at Mass. Eye and Ear in August as an Instructor of Otology and Laryngology at Harvard Medical School. Dr. Sedaghat received his medical and doctoral degrees from Johns Hopkins University School of Medicine in the medical scientist training program. He went on to complete his residency training in otolaryngology at Mass. Eye and Ear/Harvard Medical School and additional fellowship training in rhinology and sinus surgery. Dr. Sedaghat will devote much of his time to research in the areas of immunologic mechanisms of chronic rhinosinusitis and health care policy.

New Leadership

Noah Siegel, M.D., will join Mass. Eye and Ear’s new Longwood practice as Medical Director of Otolaryngology. Dr. Siegel received his medical degree from the University of Michigan and completed his general surgery internship at Northwestern University, prior to completing his otolaryngology residency at Mass. Eye and Ear/Harvard Medical School in 2000. He has spent the past 15 years as a partner at a busy community practice located south of Boston. Dr. Siegel practices general otolaryngology with subspecialty interests in sleep medicine.

The Department recently welcomed Mark Varvares, M.D., FACS, who began his new role as Associate Chair of Otolaryngology at Mass. Eye and Ear/ Harvard Medical School in February. Dr. Varvares is a familiar face to many at our institution, as he completed his residency and fellowship at Mass. Eye and Ear, in addition to spending part of his early career on the HMS faculty. He spent the last decade as the Chair of the Department of Otolaryngology – Head and Neck Surgery and Director of the Cancer Center at Saint Louis University School of Medicine.

In his new role at Mass. Eye and Ear/Harvard Medical School, Dr. Varvares will oversee clinical and research program development across the Department. He also conducts his own research and maintains a busy surgical practice in head and neck oncology.

Grant awards support projects tackling deafness through neuroengineering

The Bertarelli Program in Translational Neuroscience and Neuroengineering, a collaborative program between Harvard Medical School and the École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland, awarded a new set of grants worth $3.6 million for five research projects in October 2014. Three of the five projects will pursue new methods to diagnose and treat hearing loss, with investigators from the Harvard Medical School Department of Otolaryngology serving on the research teams with their Swiss collaborators. The research projects were all selected for their scientific quality, the novelty of the approach proposed and the potential for genuine clinical impact.

Advanced optical techniques for clinical diagnosis and therapy of hearing loss
Konstantina M. Stonkovic, M.D., Ph.D. (HMS/Mass. Eye and Ear)
Demetri Psaltis, Ph.D. (EPFL)

New generation auditory brainstem implants: translation to clinical implementation
Daniel J. Lee, M.D., M. Christian Brown, Ph.D. (HMS/Mass. Eye and Ear)
Stéphanie P. Lacour, Ph.D., Nicolas Grandjean, Ph.D. (EPFL)

Gene therapy in mouse models of human deafness
Jeffrey R. Holt, Ph.D. (HMS/Boston Children’s Hospital)
Patrick Aebischer, Ph.D. (EPFL)
Awards, Grants and Honors

Yukako Asai, Ph.D., was awarded a grant from the American Hearing Research Foundation for her project titled, “Synaptogenesis and maturation in the developing auditory system.”

Benjamin S. Bleier, M.D., received grants from Cook Group, Inc., and from Mass. Eye and Ear’s Curing Kids Fund and the Committee for Otolaryngology Clinical Trials, for his projects titled, “Analysis of biodesign as a drug permeable dural replacement in blood-brain barrier permeabilizing mucosa,” and “Randomized double blind placebo controlled trial of Verapamil in chronic rhinosinusitis with nasal polyps,” respectively.

Dr. Bleier also received two awards from the American Rhinologic Society. He was awarded Best Video Prize at the 1st Annual FESStival for his project titled, “Endoscopic bimanual approach to an orbital apex cavernous hemangioma,” as well as a Junior Member Research Travel Award to attend the 25th Congress of European Rhinologic Society in Amsterdam, Netherlands for his project titled, “Direct central nervous system pharmaceutical delivery using endoscopic skull base mucosal graft reconstruction to bypass the blood brain barrier.”

Michael S. Cohen, M.D., received a grant from the Mass. Eye and Ear Committee for Otolaryngology Clinical Trials for his project titled, “Effects of early auditory deprivation and subsequent cochlear implantation on the perception of audiovisual coherence in children.”

Pete Creighton, M.D., received the 2014 William W. Montgomery, M.D., Resident Research Award from the Triological Society for his abstract, “Does septoplasty performed at the same time as oropharyngeal surgery increase complication rates?”

Michael Cunningham, M.D., was a Visiting Professor and James A. Moore Lecturer in the Department of Otolaryngology – Head and Neck Surgery at Weill Cornell Medical College in March.

Andreas Eckhard, M.D., received an American Hearing Research Foundation award for his project, “Studies on hormone controlled endolymphatic sodium homeostasis in the endolymphatic sac.”

Albert Edge, Ph.D., and Judith Kempfle, M.D., received a grant award from Mass. Eye and Ear’s Curing Kids Fund for their project, “Development of a therapeutic strategy for auditory nerve replacement in children.”

Dr. Edge also received a new research grant award from Decibel Therapeutics, Inc., for his project titled, “Drug expanded otic stem cell.” He also received new grant awards from the Hearing Health Foundation for projects titled, “Putative hybrid cells in damaged adult organ of Corti,” and “Standardized mouse model for hearing loss studies.”

Richard E. Gliklich, M.D., received a Citation Award from the Triological Society at the 2015 Combined Sections Meeting.

Stacey T. Gray, M.D., received a Young Mentor Award from Harvard Medical School’s Office of Diversity Inclusion and Community Partnership, as part of the 2014–2015 Excellence in Mentoring Awards.

Dr. Gray also received an Honor Award from the American Academy of Otolaryngology–Head and Neck Surgery and was appointed Secretary/Treasurer and Director of Medical Education for the Women in Otolaryngology Program of the AAO–HNS.

Tessa A. Hadlock, M.D., was appointed to the Eastern Region Board of Directors of the American Academy of Facial Plastic and Reconstructive Surgery.

Christopher J. Hartnick, M.D., authored a new textbook, Surgical Correction of Pediatric Velopharyngeal Insufficiency, with first author Nikhila Raol, M.D., a clinical fellow in pediatric otolaryngology at Mass. Eye and Ear. The book was published by Karger Publishers.

Eric H. Holbrook, M.D., was appointed President of the Otolaryngology Medical Staff at Mass. Eye and Ear.

Jeffrey R. Holt, Ph.D., successfully renewed an R01 grant from the NIH for his project, “Ion channel function in auditory and vestibular hair cells.”

Faisal Karmali, Ph.D., was awarded an R03 grant from the NIDCD for his project titled, “Measuring and isolating imprecision in vestibular disease-specific quality of life outcomes in patients with nasal obstruction.”

Through the generosity of a grateful patient, Mass. Eye and Ear has endowed the annual Saumil N. Merchant, M.D., Lecture in Otolaryngology, to be held every year at the American Otological Society meeting.

Dennis Poe, M.D., received the Guest of Honor Award from the Triological Society at the 2015 Combined Sections Meeting.

Gregory W. Randolph, M.D., has been nominated for President-elect of the American Academy of Otolaryngology–Head and Neck Surgery. Voting will take place in May through electronic ballot.

Nikhila Raol, M.D., received the Arthur Tracy Cabot Fellowship at the Center for Surgery and Public Health, a joint venture of the Harvard School of Public Health and Harvard Medical School through Brigham and Women’s Hospital. Through this fellowship, she received funding to study the validity of quality metrics used for otolaryngology in the tiering system of the Massachusetts Group Insurance Commission.

Rosh Sethi, M.D., was first author on a paper that was awarded the first place poster prize at the Triological Combined Sections Meeting, titled “Predicting operating times in a tertiary care academic medical center.”

Elliott Kozin, M.D., Sid Puram, M.D., Daniel J. Lee, M.D., Stacey T. Gray, M.D., and Mark Shrim, M.D., were co-authors on the project.


David A. Shaye, M.D., was awarded a grant from the American Academy of Facial Plastic and Reconstructive Surgery to pursue a Master’s in Public Health at the Harvard

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School of Public Health, which he began in 2014. He is studying the proper role of surgery within the greater global health field.

Michelle Valero, Ph.D., was awarded a poster prize at the Association for Research in Otolaryngology for her presentation titled, “Middle ear muscle reflex in the diagnosis of cochlear neuropathy.”

HMS Promotions

Albert Edge, Ph.D., Professor of Otology and Laryngology, also named the first incumbent of an endowed HMS Chair. (See page 2 for more on Dr. Edge’s promotion)

Daniel B. Polley, Ph.D., Associate Professor of Otology and Laryngology.

Konstantina M. Stankovic, M.D., Ph.D., Associate Professor of Otology and Laryngology.

Physicians evaluate upper airway stimulation therapy for sleep apnea in adolescent patients with Down syndrome

Christopher J. Hartnick, M.D., and a team of physicians including Donald Keamy, Jr., M.D., and Gillian Diercks, M.D., of Mass. Eye and Ear, and Thomas B. Kinane, M.D., Allison T. Schwartz, M.D., and Brian G. Skotko, M.D., of Mass General, received FDA approval for a pilot study evaluating the safety and efficacy of the use of a hypoglossal nerve stimulator in the treatment of severe obstructive sleep apnea in adolescents with down syndrome. They received a grant from Inspire Medical Systems, Inc., in support of this study. The team performed the first pediatric implantation in the United States in April 2015.

Residency Program approved to accept 5 residents each year

The HMS Otolaryngology Residency Program recently received approval from ACGME to accept 5 residents per year. This represents a permanent increase from our previous agreement to accept classes of 4 and 5 residents on alternating years.

Alumni News

2007 Michael G. Moore, M.D., was promoted to Associate Professor and directed the development of a head and neck oncology and reconstructive surgery fellowship in the Department of Otolaryngology – Head and Neck Surgery at Indiana University School of Medicine, where he serves as Director of Head and Neck Surgery.

1996 Theodoros N. Teknos, M.D., was appointed Chairman of the Department of Otolaryngology–Head and Neck Surgery at The Ohio State University.

1985 Mark Weissler, M.D., was recently elected Chair of the American College of Surgeons Board of Regents. Dr. Weissler is currently the J.P. Riddle Distinguished Professor, Dept. of Otolaryngology–Head and Neck Surgery and Chief of Head and Neck Surgery at the University of North Carolina.

1983 Alfonzo Barrera, M.D., published the 2nd edition of his textbook on hair transplantation titled, *The Art of Follicular Unit Micrografting and Minigrafting*, published by Quality Medical Publishing. He was also recently named President-Elect of the Texas Society of Plastic Surgeons, and will begin his appointment as President in 2016. Dr. Barrera is a Clinical Assistant Professor of Plastic Surgery at Baylor College of Medicine.

1979 Jeffrey P. Harris, M.D., Ph.D., was a keynote speaker at the 121st Annual French Otorhinolaryngology/Head and Neck Surgery Society meeting in Paris in October. Dr. Harris will be a Visiting Professor in the Department of Otolaryngology at Northwestern University in May. Dr. Harris currently serves as Distinguished Professor of Otolaryngology and Neurological Surgery and Chief of Otolaryngology–Head and Neck Surgery at the University of California at San Diego.

1975 Robert A. Sofferman, M.D., will deliver the Keynote Graduation Address for the Department of Otolaryngology at the University of Maryland this year.
Upcoming Events

MassEyeAndEar.org/ENTCalendar

Please visit the online calendar for updated information about upcoming events in the Harvard Medical School Department of Otolaryngology, including:

- Grand Rounds
- Regular Clinical Conferences
- Visiting Professor Lecture Series
- Research Seminars
- Harvard CME Courses