

DEPARTMENT OF

# Otolaryngology – Head & Neck Surgery

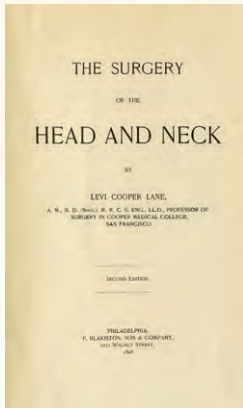
Advancing Innovation, Inspiring Research, Excellence in Care



# Milestones

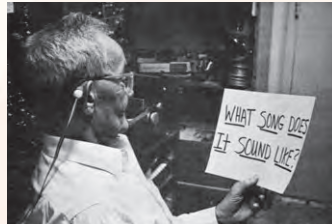
**1898**

Stanford School of Medicine's founder, Levi Cooper Lane, publishes *The Surgery of the Head and Neck*



**1964**

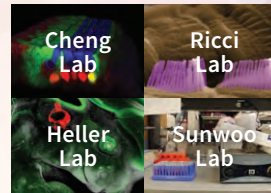
Pioneering work of multidisciplinary teams places first multichannel auditory implant



**2007**

Exploration of new and improved version of aminoglycosides begins

Research division grows to four laboratories



**2009**

The precise location of the inner ear hair cells' mechanosensors is determined

A research imaging and laboratory auditory testing facility is formally established and funded by an NIH core center grant

**1999**

Stanford Sinus Center is created

**1909**

Otolaryngology Division is founded within the Department of Surgery



Photo: The Stanford Album Photographs (PC0075), Dept. of Special Collections and University Archives, Stanford University Libraries, Stanford, Calif.

**1973**

Head and Neck tumor board is established

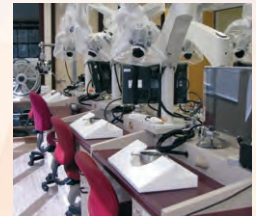
**2003**

Otolaryngology – Head & Neck Surgery is awarded departmental status

Voice & Swallowing Center opens

**2008**

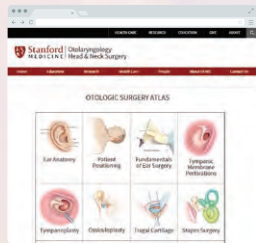
The Rodney C. Perkins Microsurgical Laboratory opens



## 2011

Thyroid tumor board is established

Otologic Surgery Atlas is created



## 2013

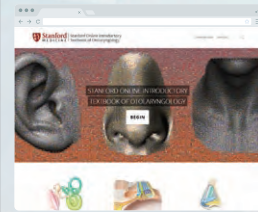
Comprehensive ENT division is formed

Targeting of cancer cells using modulators of the immune system is established

## 2015

Facial Plastic Surgery Clinic opens

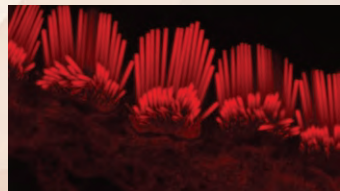
“Stanford Online Interactive Textbook of Otolaryngology,” an online resource of sophisticated medical information, is published



## 2010

Stanford Children’s Hearing Center is created, including a pediatric cochlear implant program

Functional hair-cell-like cells from embryonic and induced pluripotent stem cells are generated



## 2012

Stanford Initiative to Cure Hearing Loss (SICHL) launches

Research links tumor severity with presence of cancer stem cells in head and neck tumors

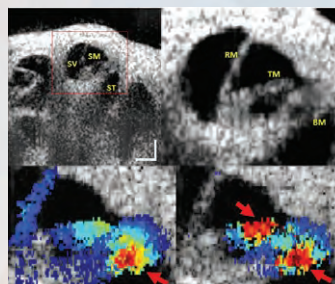
Lab work reveals role of Wnt signaling and identifies candidate stem/progenitor cells in the mammalian cochlea

## 2014

Stanford Ear Institute opens

Laryngeal Research Laboratory opens (with focus on biology of the larynx, one of only a few such labs in the world)

Optical method to non-invasively visualize structures and sound vibrations within living cochlea is developed

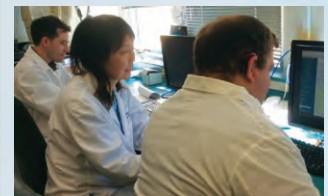


## 2016

Sleep Surgery Clinic opens

The first multidisciplinary pediatric sleep apnea clinic is slated to open

NIH T32 grant is awarded to create the Clinician-Scientist Training Program



# Industry Honors



## Stanford Hospital named one of the top hospitals in the nation

Stanford Hospital Named to *U.S. News & World Report's* 2016–17 Honor Roll—one of only 20 hospitals in the nation to earn top honors for exceptional performance in specialized, complex patient care



We are pleased to share an overview of the ways Stanford Otolaryngology – Head & Neck Surgery (OHNS) contributes to health care, scientific innovation, education, and our community. Our talented faculty, trainees, and staff strive for excellence in all of our core missions: clinical care, education, and research. In clinical care, we deliver high levels of expertise and personalized care in all of the specialty areas. Our remarkable group of surgeon-scholars in training ensures a bright future for our field. Our peerless basic and translational science faculty are both immensely creative and highly productive. In this booklet, we share stories that illustrate the type of care, teaching, and inquiry that makes Stanford OHNS such a special place.

A handwritten signature in black ink, appearing to read "R. Jackler".

**Robert K. Jackler, MD**

*Chair of Stanford Otolaryngology – Head & Neck Surgery,  
Edward C. and Amy H. Sewall Professor in Otorhinolaryngology  
and Professor, by courtesy, of Neurosurgery and of Surgery*



## Stanford Otolaryngology – Head & Neck Surgery

Ranked in the top 3% achieving national recognition

## Stanford University

Ranked in top 2 of *U.S. News & World Report's* 2016–17 Best Medical Schools for Research

## Best Doctors®

15 Otolaryngology – Head & Neck Surgery faculty surgeons listed in Best Doctors® In America

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Welcome to the story of our Stanford School of Medicine department. Since Otolaryngology – Head & Neck Surgery (OHNS) became an independent department in 2003, we have realized enormous programmatic growth increasing from 6 to 49 faculty.

Our clinical services focus on high-quality tertiary care of complex diseases in the head and neck region. We have eight clinical divisions: facial plastic surgery, head and neck surgery, laryngology (voice and swallowing), otology/neurotology (ear), pediatric otolaryngology, rhinology and sinus surgery, sleep surgery, and comprehensive ENT. Our patients come from a wide geographic area to benefit from our specialized expertise, leading surgical outcomes, and cutting-edge technology.



*Stanford Otolaryngology – Head & Neck Surgery (OHNS) faculty and trainees, 2016*

Stanford is a research-intensive school of medicine and we are a research-intensive department. The central theme of Stanford OHNS basic and translational research is to seek a better understanding of diseases in our field and to invent new therapies. Our research group, which is a mixture of basic scientists and surgeon-scientists, enjoys numerous collaborations throughout Stanford bioscience and technology. As you will see in this booklet, our research scope spans a wide variety of topics including head and neck cancer, sinonasal disease, voice disorders, obstructive sleep apnea, health care delivery innovations, and many other specialty topics. A major thrust of our research is to overcome hearing loss through regenerative means. To achieve this goal we have created the Stanford Initiative to Cure Hearing Loss, which is a long-term, goal-oriented, multidisciplinary research effort. A number of our surgical faculty, in collaboration with Stanford Biodesign and Stanford Engineering, have a special interest in medical device innovation. Together, we have more than 50 current research grants and our faculty publish more than 200 scholarly contributions annually.

We are honored that our departmental faculty include many leaders in Stanford Medicine including our Dean (Lloyd Minor), the Chief of the Stanford Health Care Medical Staff (Edward Damrose), and the Medical Director of the Stanford Cancer Center (Eben Rosenthal). Most of all, we are proud that Stanford OHNS is blessed with a warm and collegial culture and an abiding commitment to creativity, innovation, and excellence in all of our endeavors.





# Head and Neck Surgery

Furthering Our Commitment to Innovative Care, Breakthrough Research, and Exceptional Education



The dynamic Head and Neck Surgery division excels in three major areas:

- 1 Innovative, coordinated clinical care
- 2 High-impact research and discovery
- 3 Professional and patient education

LEADING EDGE + COORDINATED CARE

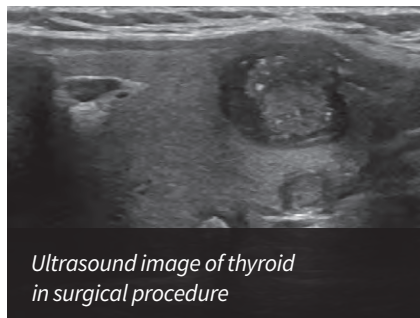
## Optimizing Care of the Thyroid and Parathyroid

Among the greatest strengths of the Head and Neck Surgery Division is our expertise in the evaluation and management of thyroid and parathyroid disorders. Our advances—particularly in ultrasound-assisted diagnostic procedures, surgery, and nonsurgical treatments—are unparalleled.

Lisa Orloff, MD, heads our thyroid and parathyroid program, working closely with colleagues Chris Holsinger, MD, and John Sunwoo, MD.

Dr. Orloff's contributions to the field of endocrine head and neck surgery have been significant. She is a pioneering researcher and practitioner in the applications of ultrasound in thyroid and parathyroid care. Her renowned work has helped bring us to the cusp of a new era of incorporating ultrasound into the practice of head and neck surgery. More surgeons now recognize its value in the examination and treatment of tumors and diseases of the salivary gland; examination of the tongue and airway in sleep surgery; tattooing, as an alternative to wire localization, to guide precise surgery; and a myriad of other applications. Ultrasound is especially valuable in pediatric cases, since it is non-invasive, uses no radiation, requires no sedation, and can be performed in the office.

Dr. Orloff's research and practice have demonstrated how ultrasound can improve patient care, decrease costs, and decrease radiation exposure in patients who have head or neck cancer. She is a former Fulbright scholar, and is a voting member of the Food and Drug Administration (FDA) panel to evaluate medical devices for otolaryngology. Dr. Orloff was our nation's first head and neck surgeon to earn accreditation by the American Institute of Ultrasound in Medicine, and is now a member of the committee for the accreditation of physicians practicing ultrasound in head and neck surgery.



## Head and Neck Surgery FACTS & FIGURES

1st multidisciplinary Head and Neck Tumor Board at Stanford, and of its kind in the U.S. in

1973

### Head and Neck Tumor Board members include:


Surgical and Radiation Oncologists • Head and Neck Radiologists • Pathologists • Nurses • Physician Assistants

### 1<sup>st</sup> organ-preservation chemoradiation in the U.S.

Our division's use of chemotherapy with irradiation for head and neck squamous cell carcinoma was first in the nation

Thyroid tumor board was established in

2011



12,000 ft<sup>2</sup>  
of research space

## Restoring the Way Cancer Patients Look, Speak, and Eat With Microvascular Reconstructive Surgery

Our team of cancer surgeons, reconstructive surgeons, and speech and swallowing rehabilitation therapists work in close collaboration to evaluate each patient for surgery, consider a reconstructive procedure and its potential functional impact, and select the procedure that can reduce the side effects of cancer treatment and restore the patient's function and appearance.

In some cases, we reconstruct a head and neck defect using tissue within the head and neck. However, in situations where the defects are too large or require special components, such as bone, our reconstructive surgeons look to tissue in different body sites and perform microvascular reconstruction.

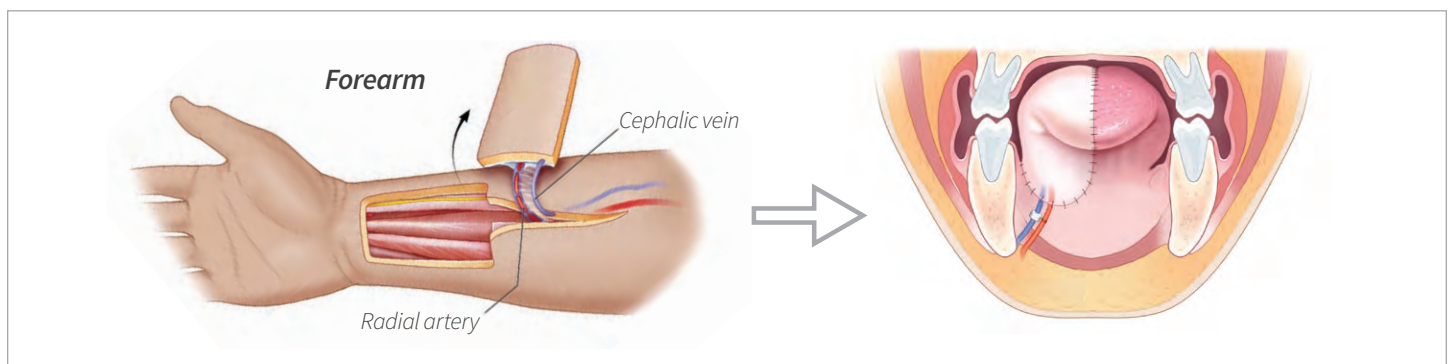
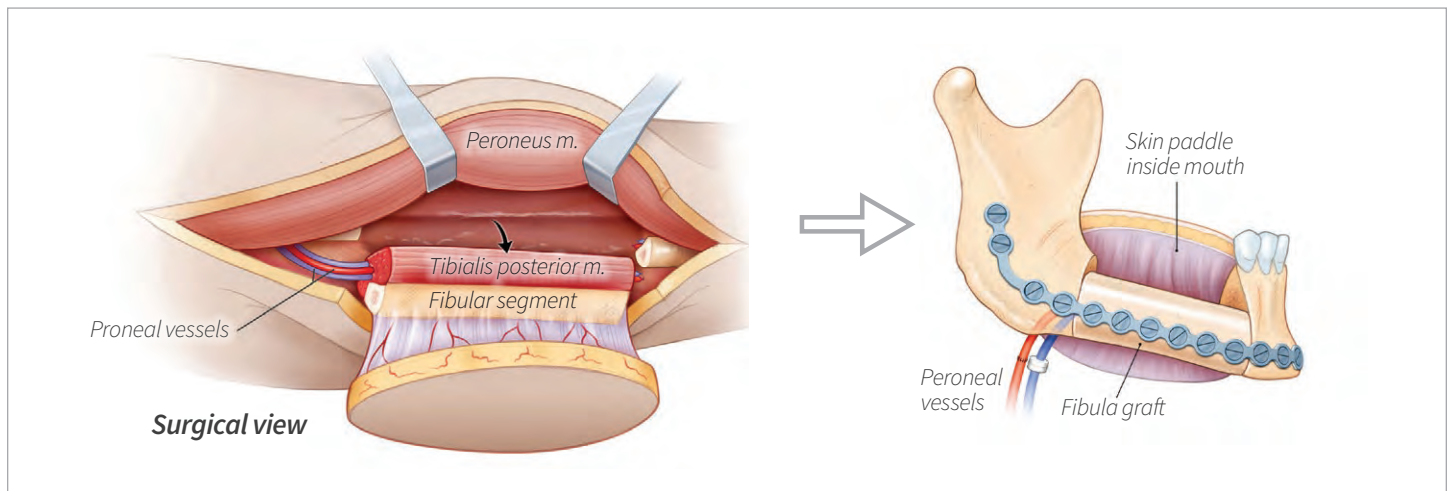
In microvascular reconstructive surgery, we move a composite piece of tissue from another part of the body to the head and neck. The tissue most commonly comes from the arms, legs, or back, and can include bone, skin, fat, and/or muscle. What to move and where to move it

depend on the reconstructive needs. Transfer of the tissue to the head and neck allows us to rebuild a jaw, optimize tongue function, or reconstruct the throat.

When pieces of tissue are moved, they require their own blood supply for survival in their new location. This is similar to how a transplant works, except we are using a patient's own body to provide the reconstructive tissue. After the reconstruction is secure in the head and neck, we reconnect the blood vessels that feed the tissue transplant to new blood vessels in the neck. Since these blood vessels are usually 1 to 3 millimeters in diameter, the connections must be done under microscope.

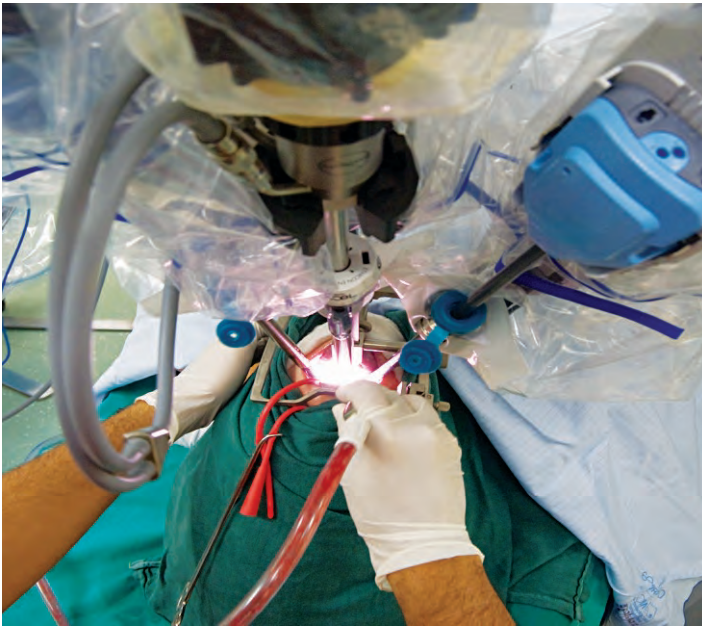
We also combine this type of reconstruction with other advanced surgical techniques, such as computer modeling, 3D printing, and customized implant fabrication.

Vasu Divi, MD, and Eben Rosenthal, MD, lead our microvascular reconstruction program.



Illustrations: Christine Galapp

## Advancing Robotics From the Lab Into Clinical Practice



Transoral endoscopic head and neck surgery (eHNS) has become an essential part of the paradigm for multidisciplinary treatment of oropharyngeal carcinoma—especially with the increasing incidence of tumors associated with the human papilloma virus. While radiation therapy given concurrently with chemotherapy is an effective treatment, concerns about late toxicity, especially with regard to swallowing, have led investigators to pursue other options for frontline treatment.

Transoral eHNS builds upon years of experience in otolaryngology using specialized endoscopes to visualize, biopsy, and remove tumors of the upper aerodigestive tract. Without external incisions and usually with little or no change in speech, appearance, and swallowing function, such a minimally invasive approach offered obvious benefits to patients. But surgeons were limited by older technologies and could not expand these approaches to provide the kind of comprehensive oncologic resections that could be achieved through “open” head and neck surgery.

In 2009, the FDA approved the use of a robotic surgical system for the treatment of benign and T1 and T2 malignant tumors of the head and neck. Robotic head and neck surgery has since revolutionized our approach, especially in patients with oropharynx cancer. Stanford

Head and Neck Surgery spearheaded a multicenter collaborative registry of patients treated with this approach, spanning 11 centers, and demonstrating high rates of disease control and few complications.

Currently, a prospective randomized clinical trial, ECOG3311, is underway to evaluate the role of robotic surgery as a means to “de-escalate” the treatment for oropharyngeal cancer. Dr. Holsinger has led the credentialing of surgeons for this study and coordinates ongoing quality assurance.

Finally, Stanford is leading the way in pioneering new approaches to robotic head and neck surgery. The initial generation of robotic surgical systems was designed for abdomino-pelvic and thoracic surgery rather than head and neck surgery. The instruments are larger than what would be ideal and have three rigid arms that can be sometimes difficult to place in a confined space such as the oral cavity, pharynx, and larynx.

Working in the robotics lab, our surgeons are studying how to implement a next-generation, single-arm flexible robotic system into clinical practice. The new system may enable several conceptual advances for the field of robotic head and neck surgery. Smaller instruments, a flexible stereoendoscope, and better ergonomics facilitate three-handed surgery in the confined space of the head and neck. These technical refinements may facilitate a more accurate appreciation of three-dimensional relationships of the pharynx and larynx and perhaps improve the quality of surgery.



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*“Stanford Head and Neck Surgery is dynamic, innovative, and across our specialty leads the way forward in patient care, research, and education.”*

*—Chris Holsinger, MD*

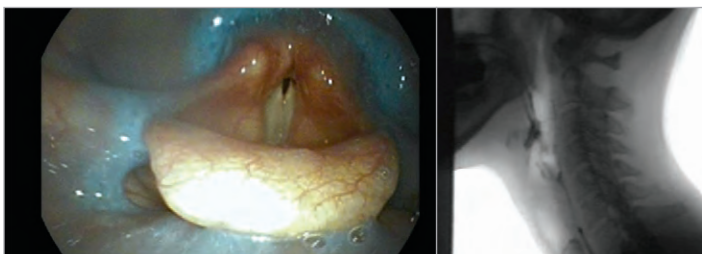
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## Specializing in Communication Disorders and Dysphagia Associated With Head and Neck Cancer

Since head and neck cancers and their treatments may impact a patient's ability to eat and/or communicate, many patients benefit from our speech and dysphagia therapy programs designed to address or prevent problems with communication and swallowing, and to optimize function and quality of life. Our team includes speech-language pathologists (SLPs) with specialized interest in the management of communication and swallowing disorders associated with head and neck cancer.

Our team has extensive experience in evaluating and treating dysphagia. Our SLPs use a number of tests to assess swallowing; the two we use most frequently are video fluoroscopy and video endoscopy.

We use video fluoroscopy to measure swallowing ability from the mouth to the throat and to the esophagus, if necessary.



Video endoscopy enables us to look at the swallowing area from above. We then observe a patient swallowing different foods and liquids to see how they travel through the throat. These tests allow us to understand how swallowing muscles are functioning so that we can customize a treatment plan for each individual patient.

Our speech-language pathology team also is engaged in clinical research to determine strategies to improve long-term patient outcomes after a diagnosis of head and neck cancer.

We believe in a proactive, preventive approach. We recommend strategies to rehabilitate swallowing function after treatment, such as exercises to strengthen muscles or improve coordination, changes in posture while swallowing, or special swallowing techniques to help patients swallow food and liquids more easily and safely. In some cases we recommend changes in food consistency, or specially designed utensils or drinking cups.

We employ a full range of modalities to manage communication and swallowing issues, all under the direction of Heather Starmer, Clinical Assistant Professor of Otolaryngology.

### RESEARCH

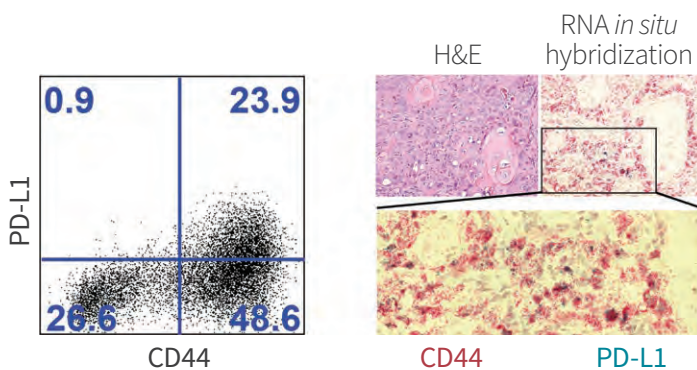
## Diverse Research Making a Profound Impact on Surgical Planning, Technique, Access, and Costs

### Conducting Groundbreaking Research into Mechanisms by Which Cancer Stem Cells Evade the Immune System

We know that cancer stem cells make up a subset of cells within a tumor that are especially resilient to standard treatment. Long after most tumor cells have been eliminated, these cells may remain and, over time, contribute to the recurrence of disease in seemingly successfully treated patients. In head and neck squamous cell carcinoma, the most common form of cancer of the head and neck, a subset of cells with cancer stem cell features has been found to express a marker called CD44. It has long been suspected that these cells, in addition to

being resistant to standard chemotherapy and radiation therapy, are also resistant to the host immune system. Whether this is true and how these cells might evade the immune system has been unclear until our division, led by John Sunwoo, MD, and a graduate student in his lab, Yunqin Lee, investigated this issue.

Dr. Sunwoo and his team recently published their findings in the journal *Clinical Cancer Research*, demonstrating that the protein PD-L1 is expressed at higher levels on the surface membrane of CD44+ cells compared to other cells within these tumors. PD-L1 plays a role in suppressing the



immune system by binding to another protein called PD-1 that is expressed on a subset of activated T cells, dampening their response to signals calling for expansion and further activation of the immune response. This research may provide critical insight into how cancer stem cells contribute to tumor cell dormancy and minimally residual disease that may recur years later. These findings also provide rationale for targeting the PD-1 pathway in the adjuvant therapy setting of head and neck cancer following surgical resection.

Dr. Sunwoo’s work paves the way for the use of a whole new generation of chemotherapeutic approaches for patients with head and neck cancer. Recent clinical trials have shown that immunotherapy using targeted antibodies to block the pathway in metastatic melanoma, non-small cell lung cancer, kidney cancer, and most recently, head and neck cancer can lead to durable regression or stabilization of disease. For these reasons, this year the American Society of Clinical Oncology is celebrating immunotherapy as the “advance of the year.”

### Deepening the Understanding of Thyroid and Parathyroid Damage to Optimize Detection and Management

The recent research of Lisa Orloff, MD, concentrates on understanding the genes that regulate parathyroid cells. One specific area of focus is the regeneration of parathyroid tissue to maintain healthy calcium levels.

Dr. Orloff’s research also encompasses partnerships with the Division of Endocrinology as well as specialists in bioinformatics at Stanford to study the effects of exposure to radiation on risk of thyroid cancer. The goals are twofold: educate the public regarding why and how to prevent un-

necessary radiation exposure, and optimize detection and management of exposed individuals later affected by thyroid cancer.

### Using Telemedicine in the VA System to Increase Access to Care While Saving Time and Money for Patients

The Veterans Health Administration has developed a robust system using telepresence technology to connect remote patients to specialized surgeons with unique expertise.

Davud Sirjani, MD, FACS, from the Head and Neck Surgery division, investigated the impact of this technology on patients with head and neck cancer. In a pilot study, Dr. Sirjani and his team showed a significant impact of telemedicine, saving patients on average 28 hours of traveling and nearly \$1,000 on travel-related costs. This demonstrates that for patients requiring highly specialized head and neck surgical care, the telemedicine model may enable more timely access to surgical care with considerable cost savings.

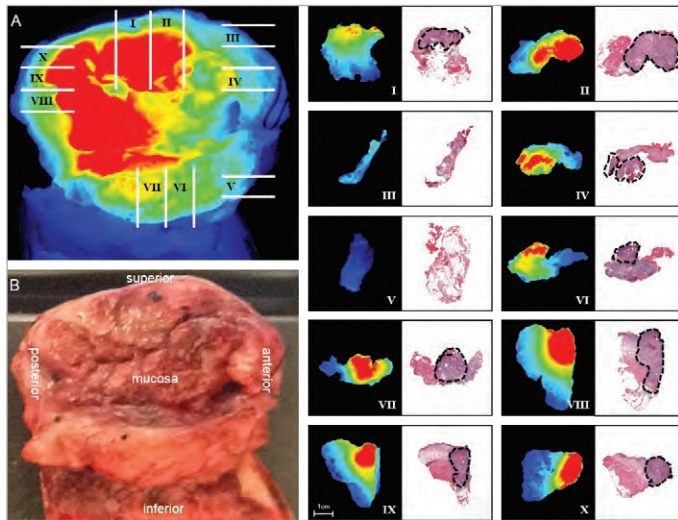


### Improving the Assessment of Surgical Margins With a First-of-Its-Kind Initiative

Eben Rosenthal, MD, Medical Director of the Stanford Cancer Center, also works as a pioneering surgeon-scientist leading a team studying the role of fluorescence-labeled antibodies, specific to cancer, as contrast agents during surgery. Over 90% of head and neck cancer is known to over-express the epidermal growth factor receptor (EGFR). The commercially available monoclonal antibody directed at EGFR—cetuximab—is one of a few new chemotherapeutic agents approved by the FDA for

systemic therapy. Dr. Rosenthal and his team successfully conjugated a near-infrared optical dye, IRDye800, to the monoclonal antibody to EGFR (cetuximab-IRDye800) and confirmed the feasibility and safety of this approach.

This work has the potential to significantly alter the way surgery is performed. Currently, surgeons must make crude estimates of what a “safe” margin should be for each patient.



Using Dr. Rosenthal’s approach, surgery can be more precise, identifying subclinical disease that may be missed with the naked eye or even surgical microscopes, but are present at the molecular level. Such clinically hidden disease or molecular “pre-malignancy” may account for recurrence of cancer after surgery. Using conjugate dyes such as cetuximab-IRDye800 might one day permit surgery that is performed, literally, at the molecular level, precisely removing at-risk tissue along the margin of a tumor, while maximally preserving normal tissue.

Such an approach might improve oncologic outcomes as well as enhance functional results following surgery. While Dr. Rosenthal is developing this approach in the easily accessible tumors of the oral cavity and pharynx, his work has broad implications within the broader field of surgery: for breast cancer, melanoma, and abdominopelvic surgery. This pioneering approach aligns closely with the mission and goals of the Stanford Cancer Institute to transform patient care.

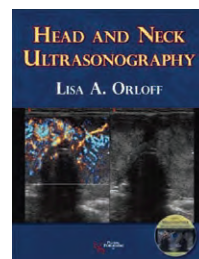
## EDUCATION

### Leading the Nation in Educational Opportunities for Head and Neck Surgeons

Stanford Head and Neck Surgeons are also leading national educators. Under the aegis of the American College of Surgeons and the American Head and Neck Society, Dr. Orloff has helped to lead the charge across the surgical disciplines to learn, master, and incorporate ultrasound technology in the clinic and operating room. Dr. Holsinger, whose research paved the way for transoral robotic surgery, leads hands-on courses for fellows and faculty to develop skills in robotic surgery.



#### Writing the Book on Head and Neck Ultrasound



Lisa Orloff, MD, authored the world’s first textbook on head and neck ultrasound. She is about to publish the second edition of this essential volume in head and neck programs as they adopt ultrasound into their core curriculum.

Dr. Orloff is also on the ultrasound faculty of the American College of Surgeons, teaching ultrasound practice to students as well as to practicing head and neck specialists who want to incorporate ultrasound into their repertoire.

Additional educational initiatives under her aegis include a video series on the optimal performance of ultrasound head and neck examination. This teaching tool will help advance the expansion of ultrasonography into otolaryngology. It also will help foster head and neck surgeons’ collaboration with sonographers and technicians.

Further extending our educational reach, Dr. Orloff traveled to Zimbabwe in 2016 to conduct a two-week training session at the University of Zimbabwe for the country's students and seven practicing otolaryngologists. The Chairman of the Otolaryngology Department at the University of Zimbabwe had visited Stanford, was immediately taken with the potential applications and

cost-effectiveness of ultrasound, and invited Dr. Orloff to his country to train his colleagues.

In the classroom, in the OR, in the clinic, around the world, the Head and Neck Surgery division is disseminating our discoveries to help professionals advance their practice and help patients receive the most effective care possible.

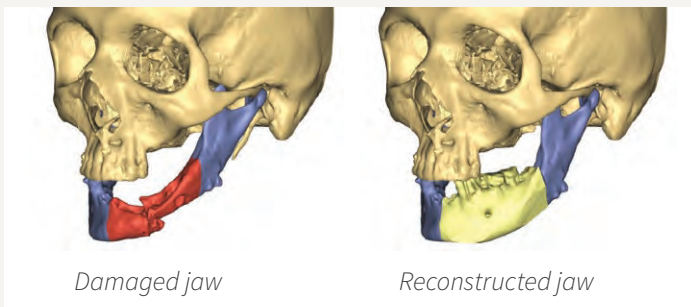
## Success Stories

### Performing Reconstructive Surgery Virtually Then in Reality to Give a Life Back

Steven Jensen had stage 4 cancer that first disfigured him and then, when his jaw fractured, impeded his ability to speak and eat. Mr. Jensen presented to Vasu Divi, MD, in our Head and Neck Surgery division. Dr. Divi implemented CT scanning, computer-aided 3D design and modeling, and virtual reconstruction before performing the actual reconstructive microsurgery.

"You have a huge advantage by creating the ideal before you get there," says Dr. Divi.

Adds Mr. Jensen, "This best thing is to have my speech and to be able to eat. It's like having my life back."

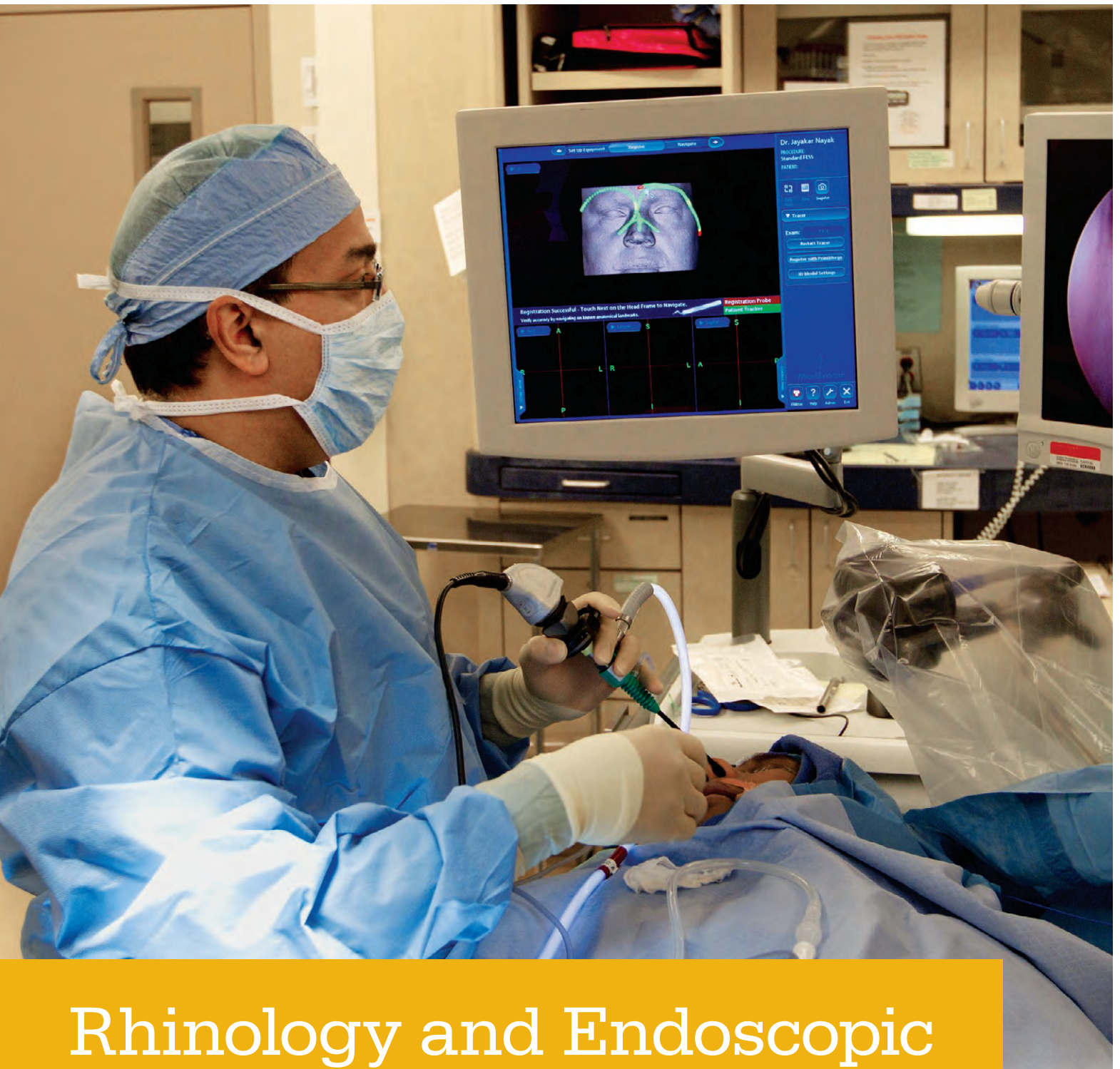


### Seeing Is Believing in Two Patients Undergoing Ultrasound-Assisted Thyroid Surgery

A Stanford alumnus, an oncologist, presented to Lisa Orloff, MD, with aggressive thyroid cancer. Beyond the fact that he is a physician himself, one more interesting detail distinguished this patient—he has an identical twin brother, who is cancer-free. (We suspect that the cause of the patient's cancer was radiation treatment in childhood for an enlarged sinus gland nearly 60 years earlier.) With ultrasound visualization, Dr. Orloff performed successful surgery, the patient is in recovery, and he is now a vociferous advocate for the use of ultrasound in head and neck surgery.

We also achieved positive outcomes with ultrasound-assisted evaluation and surgery for a young woman diagnosed with papillary thyroid carcinoma and pregnant with her first child. Using ultrasound-assisted technique, we successfully treated her cancer, and she delivered a healthy baby.

Beyond contributing to Dr. Orloff's body of evidence on the value of ultrasound in head and neck surgery, these cases, like so many at Stanford, carry a moving emotional component that complements the intellectual rewards of our efforts.



# Rhinology and Endoscopic Skull Base Surgery

Internationally Recognized—Taking On Complex Endoscopic Sinus and Cranial Base Surgery



Chronic sinusitis affects one in 10 people worldwide. The physicians at the Stanford Sinus Center, in the Division of Rhinology and Endoscopic Skull Base Surgery, evaluate “the most difficult of the difficult cases” and strive to stay at the cutting edge in the field of rhinology.

Under the leadership of Division Chief Peter Hwang, MD, this specialized team provides comprehensive medical and surgical care for disorders and complex problems of the nose and paranasal sinuses, most commonly chronic sinusitis. This includes everything from computer-assisted revision endoscopic sinus surgery to minimally invasive surgery of the skull base, orbit, and optic nerve. Through research, the Division is exploring airway tissue repair and regeneration, restoration of the sense of smell, and novel therapies for chronic sinusitis.

Founded in 1999, the Stanford Sinus Center was the first center on the West Coast to offer comprehensive medical and surgical care for sinus disease by fellowship-trained rhinologists. Today, the members of the Stanford Sinus Center include three attending rhinologic surgeons—Dr. Hwang, Jayakar Nayak, MD, PhD, and Zara Patel, MD—as well as two clinical instructors and three nurse practitioners. Together they collectively see approximately 7,500 patients and perform 1,200 surgeries, yearly. The team places a strong emphasis on integrated care, including in-clinic CT scan imaging, on-site allergy management, and interdisciplinary collaboration with a rich network of Stanford specialists.

According to Dr. Hwang, “We are advancing the specialty through innovative surgical approaches to sinusitis and sinonasal cancers, as well as through collaborative care with our partners in Stanford Neurosurgery, Oculoplastics, Allergy/Immunology, and Facial Pain/Headache Management. We have numerous specialists with broad expertise that come together when needed to provide state-of-the-art care for each individual patient’s needs.”



## Rhinology and Endoscopic Skull Base Surgery

### FACTS & FIGURES

Cumulative surgical experience of

**10,000+**  
SINUS AND SKULL  
BASE PROCEDURES

Compassionate care and cutting-edge research for empty nose syndrome and olfactory loss

### Founding institution of the **CORSICA Registry**

A collaboration with other leading academic centers for the study of sinonasal cancer

 **50**

Clinical and scientific publications in 2015

One of the most established centers for **endoscopic sinus and skull base surgery** in the Western U.S.



Host to international visiting surgeon-scholars from over

**20 countries & 6 continents**

## Meeting Complex Challenges of Skull Base Surgery

How do you operate on areas that you can't easily see or reach? Skull base tumors, which are situated at the junction of the brain and the sinuses, present unique challenges. Many tumors of the skull base that in the past were routinely managed with large, open procedures can now be removed with minimally invasive endoscopic techniques. The Stanford team was one of the early proponents of endoscopic skull base surgery, a relatively new surgical discipline. Leveraging



high-resolution imaging platforms and intraoperative surgical navigation technology, surgeons can now precisely map the location of tumors in relation to the brain, eyes, nerves, and vessels to plan the best approaches for complete removal or decompression of the disease process, while also minimizing the risk of injury to critical anatomic structures. By removing skull base tumors through the nose, surgeons can often avoid external incisions and craniotomies, resulting in shorter hospital stays and more rapid recovery.

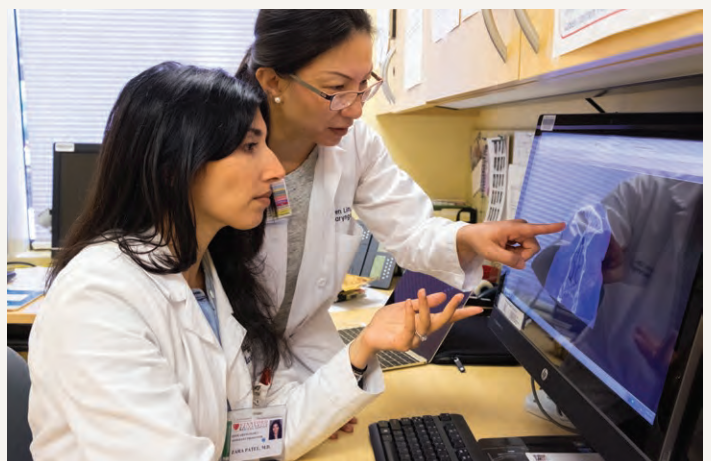
In partnership with neurosurgeons from Stanford, Drs. Hwang, Nayak, and Patel have the expertise to perform endoscopic surgical approaches from the frontal lobe of the brain to the upper cervical spine through an entirely endoscopic nasal approach. For patients with skull base cancers, the extended team also includes radiation oncologists and medical oncologists, working together to offer comprehensive management of the most challenging tumors.

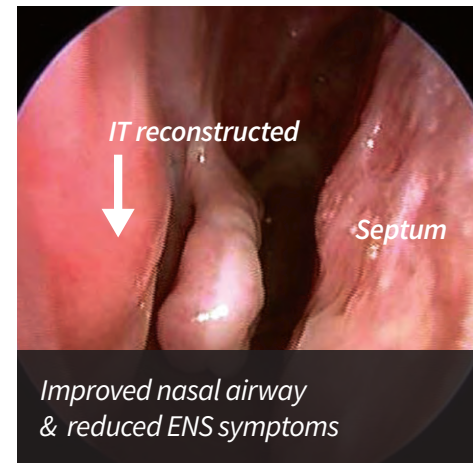
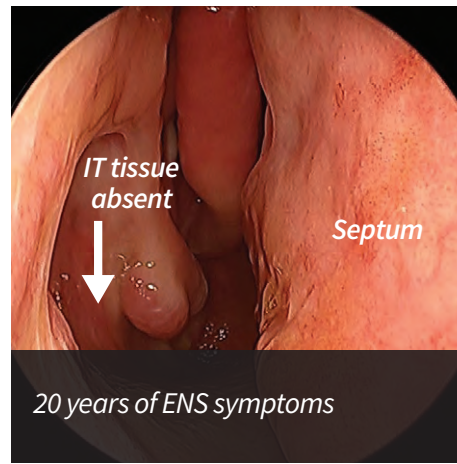
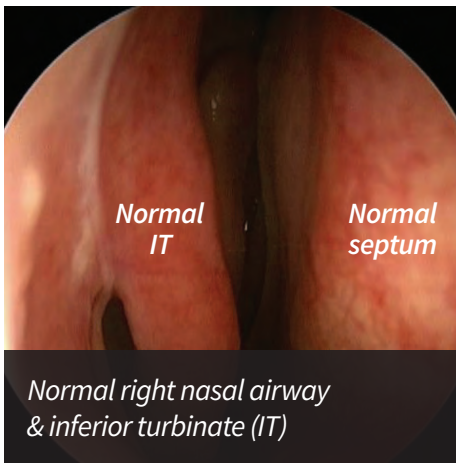
## Success Stories

### Endoscopic Tumor Resection

Michael Bailey originally presented with nasal congestion, loss of smell, and nosebleeds. Mr. Bailey had visited outside emergency rooms on and off for months with nosebleeds, had his nose packed repeatedly, and even underwent arterial embolization before a mass was discovered in his nose, which Dr. Patel diagnosed as squamous cell carcinoma of the sinonasal cavity. After meeting the patient and discussing his multidisciplinary care at the weekly Stanford Tumor Board conference, Dr. Patel was able to take him to the operating room for a complete endoscopic tumor resection and rapidly advance him into adjuvant treatment with chemoradiation therapy. Mr. Bailey has now completed his full course of cancer treatment, and is immensely grateful for the swift and coordinated care

he received once evaluated here at Stanford. He is now in complete remission, and Mr. Bailey credits Dr. Patel and his team of Stanford physicians for his new lease on life.





## A Leading Destination for Empty Nose Syndrome and Nasal Physiology

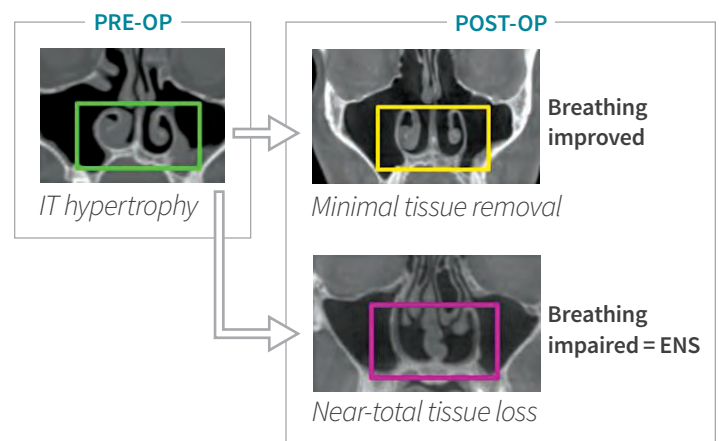
Nasal suffocation, unexplained nasal blockage and dryness, loss of smell, facial or nasal pain, and depression are just some of the wide constellation of symptoms associated with the enigmatic disorder termed empty nose syndrome (ENS). Patients with ENS report that their nose is too open but still describe paralyzing degrees of suffocation, resulting in panic, insomnia, fatigue, anxiety, and depression. Despite the debilitating impact on the quality of life for some patients, there remains ongoing controversy in many circles about the underlying basis, and even the existence of, this syndrome.

For Dr. Nayak, these circumstances demand improved research using modern strategies and well-designed studies to understand ENS, and more broadly, nasal airflow and physiology. Although ENS is uncommon, it is frequently associated with past partial or complete inferior turbinoplasty procedures, a nasal procedure performed worldwide. Adding to the complexity, ENS is also occasionally found in individuals who have normal turbinate tissue and intranasal volume.

Stanford is one of the leading centers internationally for the diagnosis and treatment of ENS, including innovative turbinate reconstruction procedures. Dr. Nayak is the only surgeon on the West Coast regularly evaluating and performing surgery for ENS, drawing on a national and international referral base. Dr. Nayak has been spearheading patient-centered ENS research, striving to understand the physiology of nasal breathing and how surgical reconstruction options can optimally restore nasal and breathing function. Dr. Nayak's paper on

creating and validating a highly reliable questionnaire to support a diagnosis of ENS was given the award for "Best Clinical Research Paper" at the American Rhinologic Society Spring Meeting in Chicago in May 2016.

"Today, the assessments of clinical outcomes of ENS treatments primarily depend on limited indicators, such as patient history and nasal examination," explains Dr. Nayak. "Because of our interest in ENS and the number of patients fortunately interested in seeing us and participating in our research programs, we can now make inroads into understanding ENS more globally from measuring metrics such as quality of life, sinus imaging, and objective airflow testing. We can also test the impact of potential treatment options with each individual. We are trying to understand ENS, and therefore nasal physiology, on many levels, from breathing and airflow measurements to the effects on anxiety and sleep. We feel this challenging ENS disease can be better understood when distilled down to impaired, but reparable, physiology and function."





## Global Leadership in Rhinology at Stanford

The Stanford Sinus Center maintains a highly regarded national and international profile as one of the top centers in the world for clinical care and research in Rhinology and Endoscopic Skull Base Surgery. On a weekly basis, surgeons from around the world come to the Sinus Center as part of the International Observers' Program to learn the most up-to-date office practices and to observe advanced surgical cases. The Visiting Research Scholar Program is another avenue for international collaboration, wherein faculty rhinologists from overseas institutions come to Stanford for one to two years to perform clinical and basic research. The Visiting Scholars then return to their home institutions poised to become academic leaders in rhinology in their home countries. Recent scholars have hailed from Brazil, China, Colombia, Japan, Korea, Morocco, and Taiwan. In addition to training otolaryngology residents, the faculty in the Stanford Sinus Center also offer a highly regarded fellowship training program in rhinology, drawing applicants from across the U.S. and the globe.

The Sinus Center is also conducting globally minded research in the area of surgical telementoring for endoscopic sinus surgery. Using a web-based, interactive video teaching model, Dr. Hwang and colleagues are evaluating the efficacy of remote, real-time teaching of surgical skills via two-way, livestreamed video sessions. Dr. Hwang hopes this technology can ultimately be applied to teach operative techniques to surgeons working in underserved regions of the world, where access to learning opportunities may be severely restricted.

Drs. Hwang, Nayak, and Patel serve frequently as invited speakers at a variety of international venues, with recent destinations including Sweden, Dubai, and the Czech Republic. These invitations reflect the recognition of the Stanford faculty's leadership in academic rhinology. Dr. Hwang currently serves as the President of the American Rhinologic Society; Dr. Patel is currently Chair of the Education Committee for the American Rhinologic Society; and Drs. Hwang and Nayak have contributed to the recent International Consensus Statement on Rhinosinusitis.

## A Focus on Upper Airway Biology

In the basic science arena, Dr. Nayak's research laboratory is one of few in the world exploring the frontiers of nasal, sinus, and upper airway biology at the basic science and clinical translational levels. Dr. Nayak's lab group focuses on two basic research directions: (1) upper airway mucosal tissue repair and regeneration using stem cells; and (2) human airway immunology. His lab members are exploring the world's first airway stem cell transplants in culture systems and animal models, using naturally occurring, potent upper airway stem cells that they have identified. This stem cell-based research may pave the way for clinical trials to treat patients suffering from empty nose syndrome and other upper airway disorders such as cystic fibrosis within this decade. In addition, this research may herald a novel, cell-based treatment paradigm for patients who currently suffer from a variety of lower airway disorders incited by airway tissue loss and injury.

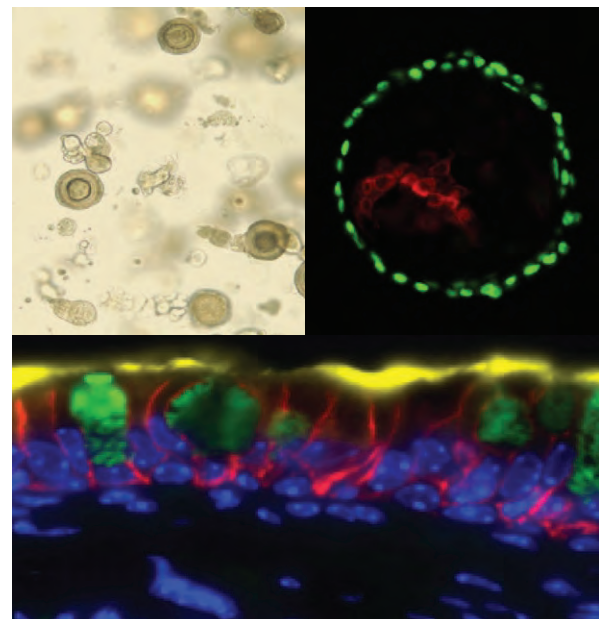
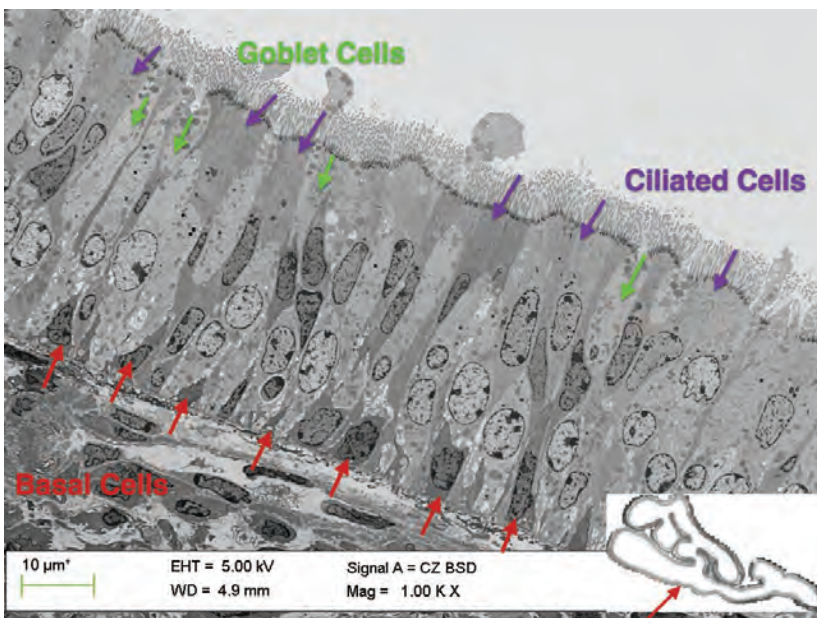
In parallel, Dr. Nayak's research has also recently discovered that inflamed human upper airway tissues have significant proportions of specialized B cells—finely tuned immune cells that make protective immunoglobulins. In collaboration with colleagues from Northwestern University, these B cells appear to be highly unique and primarily found in the inflamed upper airway tissues, and to not control

nasal tissues or the circulating blood, suggesting that this region of the human body harbors an undiscovered microenvironment at the junction between the innate and acquired immune systems.

This basic science research promises to: first, eventually regenerate or regrow resected or damaged upper and lower airway tissues to benefit patient care; and second, reverse or mitigate the immune system derangements that are found in, and may drive, inflammation as seen in chronic sinusitis patients.

This patient-centered research covers empty nose syndrome and clinical translation research in areas including normal and pathologic physiology of upper respiratory airway biology in chronic inflammation. It may also lead to creation of the next generation of topical sprays and rinses that eliminate chronic upper airway inflammation and better treat recurrent infections.

The Nayak Lab collaborates with the laboratories of Mark Krasnow in Biochemistry; Tushar Desai in Pulmonary Medicine; Stanford Bio-X (interdisciplinary research and teaching at the crossroads of bioengineering, biomedicine, and bioscience), Lee Herzenberg in Immunology and Genetics; and researchers at UC Berkeley and Northwestern.



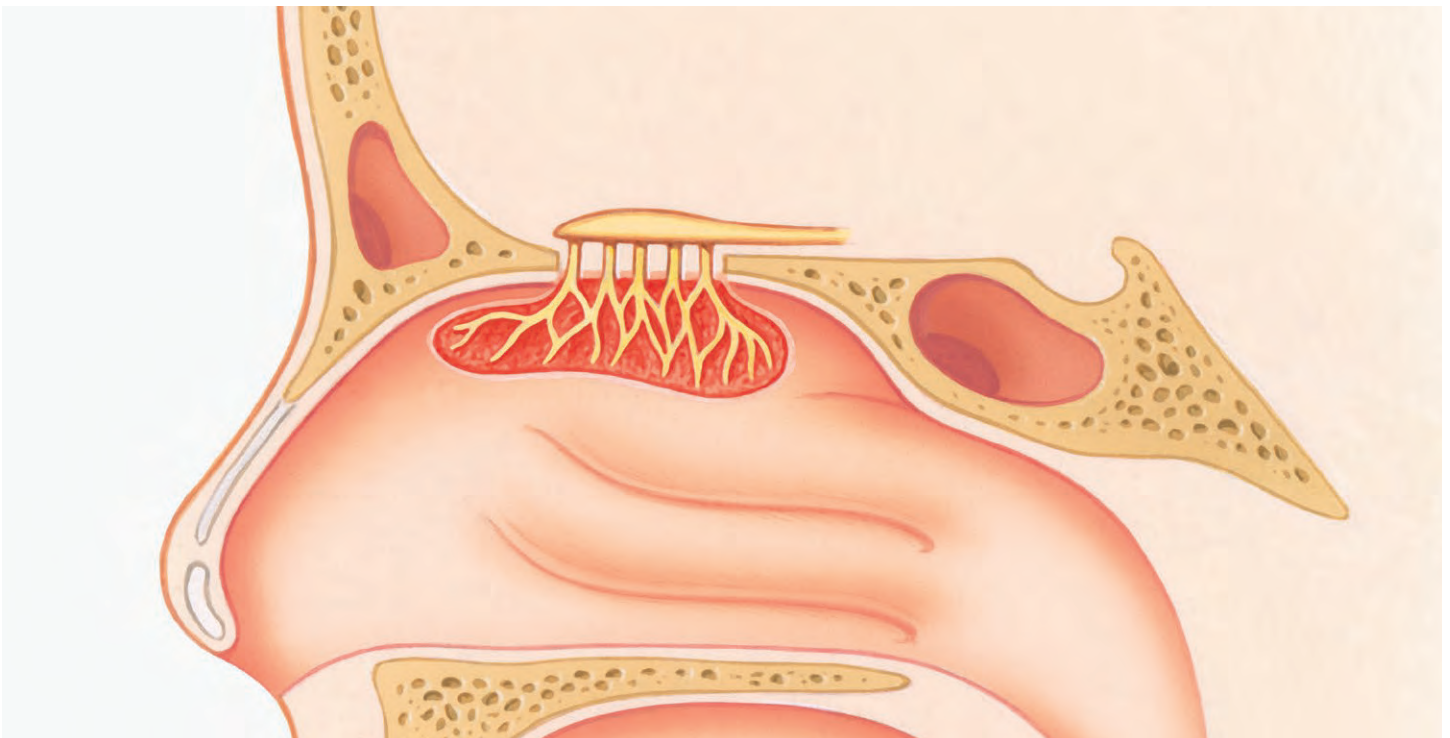
## Research on the Cure for Olfactory Loss

Dr. Zara Patel joined the Rhinology Division in September 2015, bringing with her a new clinical and research focus on olfactory loss. She developed a deep sympathy for patients in her clinic who suffered from a lost sense of smell and taste, and a resulting drastically diminished quality of life. These patients were desperate for a cure, and unfortunately, until recently, there was little to offer. She realized that although the basic science research in olfaction was exploding, clinical research had lagged far behind. She set out to determine which novel clinical studies held the greatest promise for this patient population and came upon olfactory training. The technique of olfactory training consists of patients performing daily repetitive exposures to known scents in order to retrain the synaptic pathway that governs recognition of smells. Studied widely in Europe, with a high level of evidence supporting its efficacy in about half of patients studied in placebo-controlled trials, olfactory training finally offers a ray of hope for patients with smell loss. Dr. Patel began offering this treatment to her own patients, not only replicating the results of past studies but also developing innovations to make treatment protocols more cost-effective and practical. She is now also studying this methodology in new patient

populations such as nasopharyngeal and paranasal sinus cancer patients following radiation therapy.

While olfactory training research confirms that the regenerative capacity of the olfactory system is not completely disrupted in these patients, many patients are unfortunately still left without improvement. This galvanized Dr. Patel to reach out to colleagues in the Physics and Bioengineering departments here at Stanford University, and with their help she is now working to develop a cutting-edge procedural treatment for patients with olfactory loss.

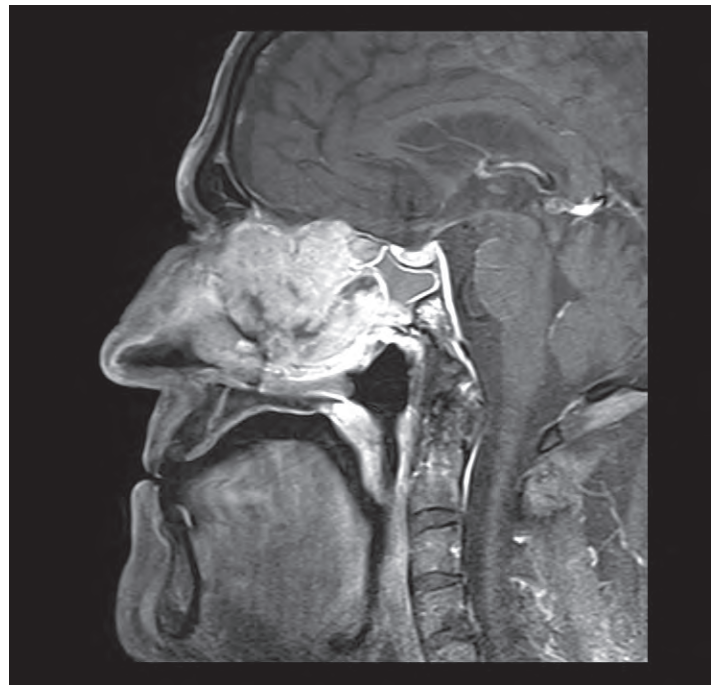
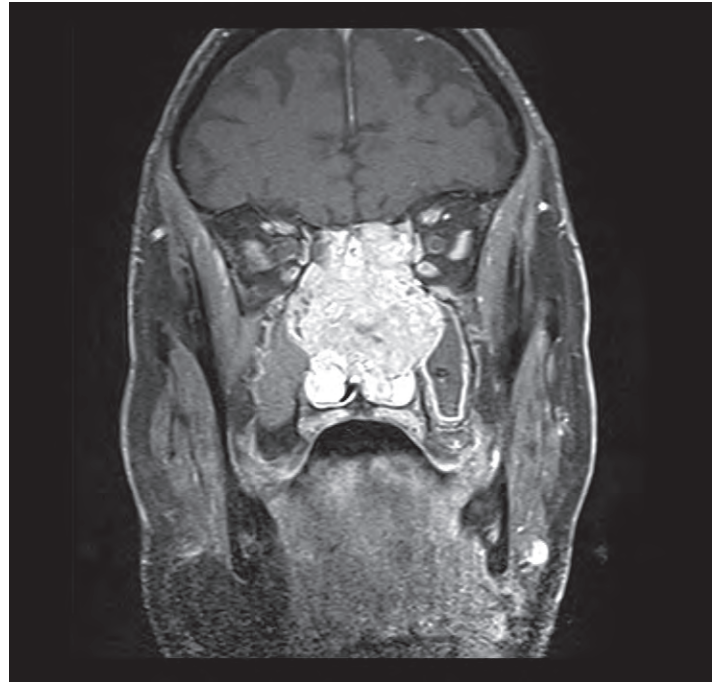
In addition to working with this distinct patient population, Dr. Patel continues to conduct clinical research on chronic sinusitis and endoscopic skull base surgery, and has been able to help thousands of patients with chronic sinusitis as well as sinus and skull base neoplasms. She is currently directing studies evaluating decision analysis regarding treatment paradigms in chronic sinusitis patients, as well as investigating innovative therapeutic modalities for rhinosinusitis patients as well as chronic rhinitis patients. She treats patients with both benign and malignant skull base tumors and enjoys the unique technical challenges that endoscopic tumor resection presents.



## Stanford Leads Initiative for Multi-institutional Registry for Patients With Sinonasal Malignancy

Cancer of the nose and sinuses is a rare but potentially devastating illness. Due to the low incidence of sinonasal malignancy (0.5 to 1 case per 100,000), the research literature offers uneven guidance regarding best practices for optimal treatment of these patients. In order to improve doctors' abilities to assess the long-term outcomes of treatment for patients with sinonasal cancer, Dr. Hwang, along with fellow faculty member Dr. Chris Holsinger, conceived a multi-institutional clinical registry that uses cloud-based computing to evaluate treatment outcomes in patients with sinonasal cancer. Funded by the Cole-Reagins Family Foundation after the death of a family member from sinus cancer, the Cole-Reagins Registry for Sinonasal Cancer (CORSICA) is a Stanford-led national initiative with seven top cancer centers enrolling patients. CORSICA will gradually expand to 10 national and international centers, with a goal of enrolling 150 to 200 patients into the database yearly. Details on the registry design methodology, study population, and clinical endpoints were recently published in a scientific paper in *The Laryngoscope* of the American Laryngological, Rhinological and Otological Society, in 2016.

Although just recently launched, CORSICA will ultimately inform management decisions and disease prognostication in sinonasal cancer. By leveraging cloud-based computing to secure multi-institutional collaboration, the hope is that CORSICA may serve as a model for future registry development for the study of other rare diseases in otolaryngology.





# Laryngology



## Comprehensive Treatment of Voice, Swallowing, and Upper Airway Disorders

### An Integrated Holistic Approach

Voice, speech, and swallowing. It's what makes us who we are as individuals, and when things go wrong, it can have a devastating impact on our quality of life. Millions of people worldwide are affected by disorders of the larynx, airway, and upper esophagus that interfere with their ability to speak, breathe, and swallow. Under the leadership of Chief Edward J. Damrose, MD, FACS, the Stanford Division of Laryngology specializes in state-of-the-art vocal care for those who use their voice professionally, and leading edge assessment and treatment for anyone with any type of voice, upper airway, and swallowing disorder. The Division also uses some of the most sophisticated high-technology tools such as high-speed videoendoscopy (HSV), high-definition digital videostroboscopy, and more.

Many innovative laryngeal surgeries and treatments have taken place at Stanford Voice and Swallowing Center, from robotic transoral procedures for head and neck cancers to new research into deep brain stimulation for vocal tremor to office-based treatment of laryngeal pathology. The Division of Laryngology offers an integrated, holistic approach by treating patients both medically and behaviorally, and leverages a distinct advantage in collaborating with other departments across the institution including the renowned Stanford Neurology and Neurosurgery departments. From MD surgeons to behavioral voice therapists, the staff of the Stanford Voice and Swallowing Center diagnose and treat a range of disorders including benign and malignant vocal fold lesions, vocal fold paralysis, spasmodic dysphonia, Zenker's diverticulum, and airway stenosis.

*Dr. Damrose is one of the nation's few experts in a laryngeal cancer treatment that saves patients' voices called "supracricoid laryngectomy with cricothyroidopexy."*

His colleague C. Kwang Sung, MD, MS, performs a wide array of in-office laryngeal procedures, including those requiring use of a laser. Dr. Sung—a professionally trained singer—also has a strong interest in care of the professional voice, especially in entertainers. Speech-language pathologists Elizabeth Erickson-DiRenzo, PhD, CCC-SLP, and Ann Kearny, MA, CCC-SLP, BCS-S, provide behavioral care for a wide range of voice, swallowing, and airway disorders.

Dr. Erickson-DiRenzo has recently established the Laryngeal Research Laboratory—one of only a few specialized laboratories in the country that investigate the biology of the larynx. Drawing on techniques from the basic sciences and human clinical sciences, she hopes to improve the prevention and management of voice disorders.

## Laryngology FACTS & FIGURES

Voice and Swallowing  
Center opened in

2003



400+

surgeries annually



Offers multidisciplinary  
management of voice disorders  
and laryngeal cancer

3000+

patient visits per year

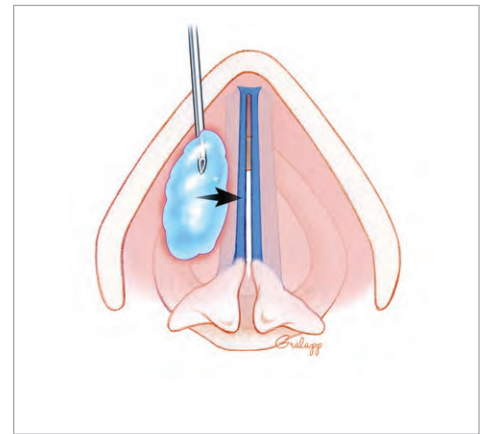
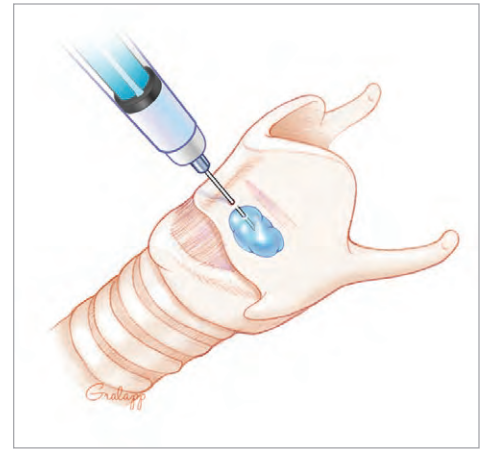
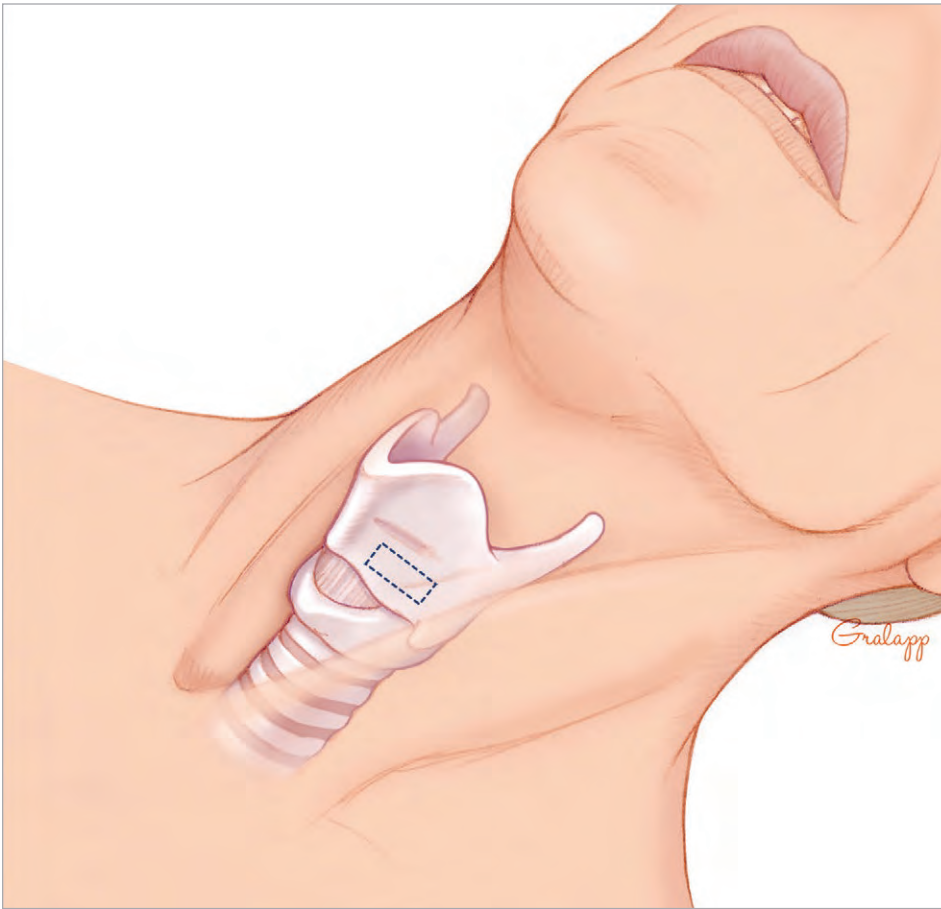


One of only a few innovative  
laboratories to focus on biology  
of the larynx in 2014

Involved in

02

clinical trials



Illustrations: Christine Gralapp

## The Most Sophisticated Technology for Assessment and Treatment

For assessment of voice and swallowing disorders, the Laryngology Division uses some of the most advanced techniques for vocal fold imaging (visualization) and voice analysis. These techniques uncover new phenomena in the mechanism of voice production, and help us better understand laryngeal pathology and its impact on voice quality, and determine optimal treatment. Through the use of HSV—the most powerful tool for vocal fold vibration to date—and the use of high-definition digital videostroboscopy, we're able to get a comprehensive assessment of the structure of the vocal folds and vibratory characteristics.

Stanford's sophisticated voice analysis suite includes equipment necessary for acoustic and aerodynamic evaluation of voice production. Flexible endoscopic evaluation of swallowing (FEES) can be performed during a normal office visit to assess for swallow and make recommendations for improved safety and efficiency. This exam is recorded to help with patient education and tracking of a patient's swallowing progress.

For treatment, we offer laryngeal EMG and Botox injections (in office) to help with voice disorders such as spasmodic dysphonia. We are also one of the few facilities in Northern California to employ pulsed-Potassium-Titanyl-Potassium (KTP) laser treatments on an outpatient basis. With this technique, physicians remove lesions from the vocal fold during a minimally invasive procedure that requires little to no recovery time.

We also routinely perform medialization procedures for vocal fold paralysis that include vocal fold injections done in the clinic with local anesthesia or in the operating room under general anesthesia. A permanent implant can be done in the operating room.

With our microlaryngeal surgery—a minimally invasive procedure—we routinely correct voice disorders. During the procedure, an operating microscope is used to greatly magnify the vocal folds and allow the surgeons to visually examine the area while operating on it to remove abnormal growths in the larynx such as polyps, cysts, and benign tumors.

## Deep Brain Stimulation—Investigating a Novel Therapeutic Option for Essential Voice Tremor

Vocal tremor is a common and often debilitating voice disorder with no known cure and limited effective treatments. Patients with vocal tremor often report an unsteady voice with a necessary increase in vocal effort that significantly worsens with stress and anxiety. Vocal tremor can significantly impact quality of life despite medical and behavioral treatment. Consequently, the Division of Laryngology is researching a novel therapeutic option for vocal tremor.

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*Deep brain stimulation (DBS) of the thalamus has emerged as a leading and effective surgical intervention for essential tremor of the limbs, and is used in Stanford Neurology and Neurosurgery to help patients with movement disorders, psychiatric disorders, seizures, and certain types of chronic pain.*

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While many leading edge techniques for DBS procedures were pioneered at Stanford, the effects of DBS treatment on vocal tremor are virtually unknown. The Stanford Laryngology Division hopes to change that situation.

Drs. Erickson-DiRenzo and Sung are actively collaborating with clinicians and scientists within the departments of Neurology and Neurosurgery to perform the first systematic and prospective evaluation of the effect of DBS on vocal tremor.

Results will provide a necessary foundation for future studies that seek to optimize DBS for the treatment of vocal tremor and have the potential to alter treatment paradigms for these difficult-to-serve patients.

A technical paper in *Neurosurgical Focus* (2015) on the multidisciplinary, comprehensive operative methodology covers the assessment of vocal tremor during frameless, awake DBS paired with a comprehensive laryngoscopic and vocal acoustic analysis. Drs. Erickson-DiRenzo and Sung believe this is the first time comprehensive intra-operative voice evaluation has been used to help guide microelectrode/stimulator placement, as well as the first time that comprehensive pre- and post-DBS assessments have been conducted, investigating the efficacy of this tailored DBS approach. Given the encouraging results from the initial experience with this methodology, a continued prospective study of DBS for vocal tremor is currently underway to more robustly quantify the efficacy of this treatment modality.

To support this valuable work, Dr. Erickson-DiRenzo and the Division of Laryngology received an American Speech-Language-Hearing Foundation New Investigators Research Grant during the 2015 Convention of the American Speech-Language-Hearing Association (ASHA) in Denver, Colorado.

## Assessing and Measuring Voice Production—Voice Laboratory

One of Stanford Medicine's goals is to make enhancing precision health a priority. In keeping with our Precision Health Initiatives, the Division of Laryngology has initiated a multidisciplinary assessment program for patients with voice disorders. Voice assessment and treatment by qualified health care professionals is a significant factor in improving vocal function and reducing the recurrence of future voice disorders. In the Stanford Voice and Swallowing Center, care of patients with voice disorders is multidisciplinary through the combined efforts of laryngologists and speech-language pathologists. Complete evaluation of voice disorders by



these professionals depends on the use of comprehensive, multidimensional voice assessment procedures in order to characterize normal and pathological voice. This permits the following:

- determine whether a patient’s voice is normal or pathological and the severity of the alteration;
- determine which aspects or mechanisms of voice production are involved in the patient’s voice disorder;
- enable valid comparison of assessment results within and across patients and facilities; and
- facilitate the evaluation of treatment efficacy and effectiveness.

According to Dr. Erickson-DiRenzo, who is spearheading this endeavor, “A complete clinical voice evaluation should optimally include laryngeal imaging, acoustic, and aerodynamic assessment, in addition to other non-instrumental parts of the evaluation including perceptual assessment of voice and self-report instruments.”

She believes that the use of all instrumental and non-instrumental approaches is deemed necessary because together they more fully characterize the fundamental components of voice production.

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*In the Voice and Swallowing Center, a voice laboratory for measurement, archiving, and analysis of voicing parameters, including imaging, acoustic assessment, and aerodynamic assessment, has been established.*

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It dovetails with Stanford’s focus on precision medicine. This voice laboratory enables them to characterize aerodynamic forces required for producing phonation, vocal fold vibratory function, and the characteristics of the sound produced.

The Division of Laryngology believes it is their responsibility to strive to improve the quality of care for voice-disordered patients through clinical research. With the standardized voice assessment procedures described above, a significant amount of data regarding all aspects of voice production is being collected. Consequently, the team developed a clinical voice database to facilitate future research regarding a variety of voice concerns. This database allows for the examination of clinical characteristics for a variety of voice disorders and outcomes following a wide range of interventions.

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TEACHING + TRAINING

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## “Playing With Food” Simulates Specialized Surgery to Improve Voice

Dr. Sung and colleagues at Stanford have developed a decidedly low-tech, low-cost approach to phonomicrosurgical simulation. Phonomicrosurgery requires operating on tiny lesions involving the delicate tissues of the vocal folds using instruments that are 20 to 25 cm long while working under magnification through a small space under an operating microscope. This specialized skill is difficult to practice, and the limited number of cases makes it hard for trainees to achieve mastery of the techniques. The Stanford teaching model used a grape imbedded in gelatin, a microscope, and microlaryngeal instruments—along with some PVC piping from the local hardware store. At the Stanford Perkins Microsurgery Teaching laboratory, Dr. Sung performed this phonomicrosurgical simulation study with the Stanford otolaryngology residents and

fellows. Designed to test baseline differences in training levels, it also looked at improvement in performance after training with the simulation model.

According to the paper published in *Laryngoscope* (April 2016), 30 subjects enrolled in the Stanford otolaryngology training program performed microlaryngeal surgery tasks on grapes. Tasks were designed to model both excision of a vocal fold lesion and vocal fold injection. Video recordings comparing pre-simulation and post-simulation training were collected and graded by two expert laryngologists. Both objective comparison of skills and subjective participant surveys were analyzed.

According to Dr. Sung, “Trainees in all groups made statistically significant improvements across a range of

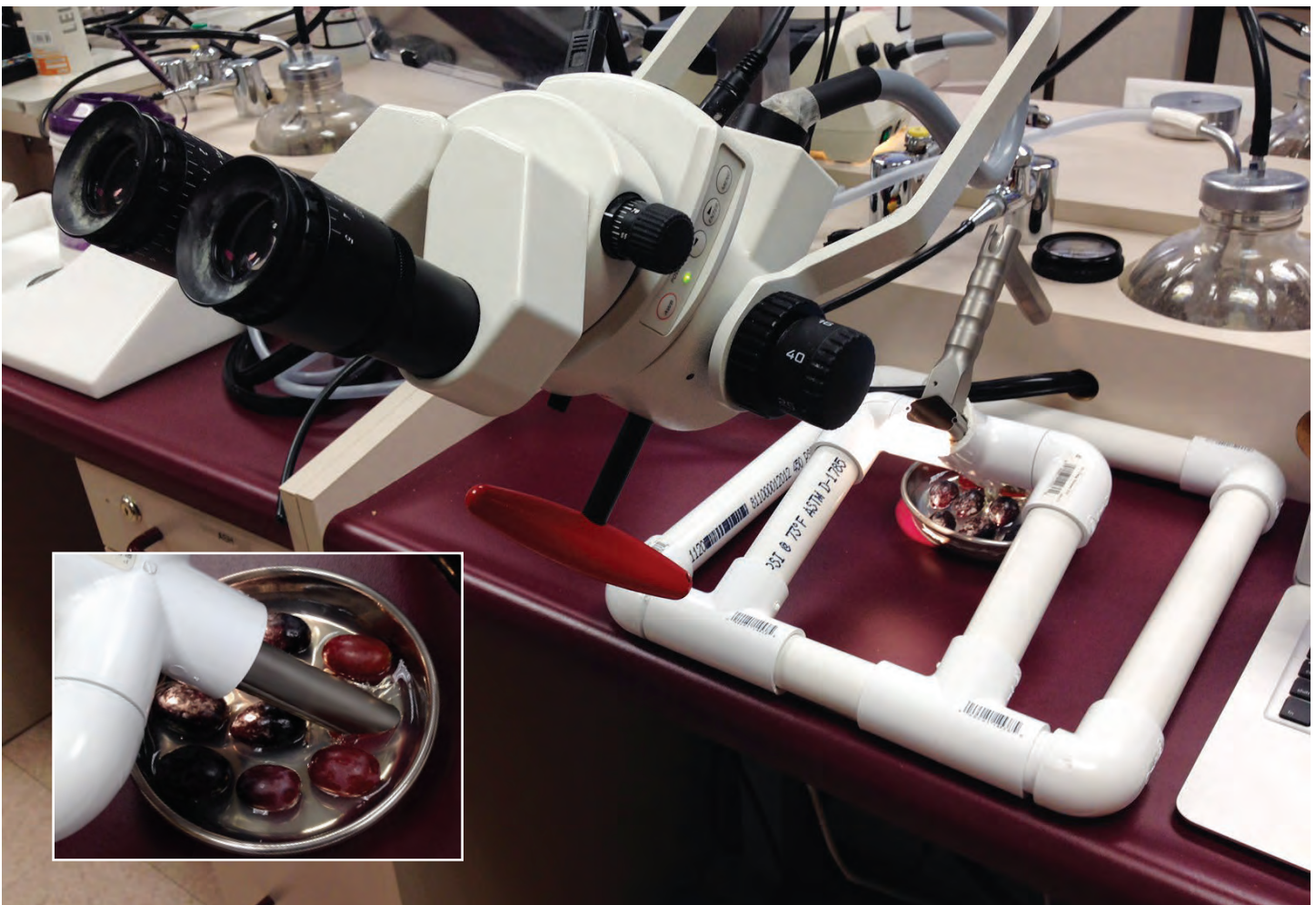
simulation tasks, including microscope positioning, creation of a linear incision, elevation of epithelial flaps, excision of a crescent of tissue, vocal fold injection, preservation of remaining tissue, and time to complete all tasks. All the participants felt that they had increased comfort with microlaryngeal instruments and were less intimidated by microlaryngeal surgery after completing the simulation training.”

The study concluded that microlaryngeal surgical simulation using the grape model is a tool that can be used to train residents to prepare them for phonosurgical procedures at all levels of training. Dr. Sung’s low-cost model can be used to introduce trainees to microlaryngeal surgery or improve skills of more senior trainees in a safe, low-stress environment. Playing with food may truly lead to better surgeons and enhanced patient outcomes.

## A Decade of Advanced Fellowships

Since 2006, the Division has offered a fellowship in advanced laryngeal surgery and has trained eight fellows to date, while hosting 10 visiting professors. Every year, the Division offers one to two courses on diverse topics such as voice, airway, and swallowing.

For example, the Stanford Tracheo-esophageal Voice Restoration and Laryngectomy Care Workshop, held in conjunction with the Department of Rehabilitation, entered its 11th year in 2016. The Stanford Advanced Airway Management and Fiberoptic Intubation Course, held in conjunction with the Department of Anesthesiology, entered its fourth year in 2016.



## Uncovering New Discoveries, Developing Novel Interventions at New Laryngeal Research Lab

How do environmental stresses like cigarette smoke and e-cigarette vapor compromise the structure and function of the laryngeal tissues? These questions and many others will be explored at the newly opened Laryngeal Research Laboratory at Stanford. This is one of only a few labs in the country that study the biology of the larynx, specifically the protective laryngeal epithelial and mucus barriers.

Voice disorders affect millions of people in the United States annually. To truly understand the etiology of voice disorders and improve prevention and treatment, the cellular and molecular underpinnings of laryngeal development and the vocal fold response to potentially hazardous environmental stresses must be understood. Directed by Dr. Erickson-DiRenzo, the new laboratory investigates cellular

and molecular events in the epithelial and mucus barriers triggered by these environmental factors and the processes that lead to the development of vocal fold diseases. The lab connects these findings to patients exposed to similar stresses to better understand how the biological changes to these barriers may influence voice production.

The ultimate aim in the laboratory is to use research discoveries to develop novel interventions involving the epithelial and mucus barriers to prevent and treat voice disorders. To achieve this aim, Dr. Erickson-DiRenzo uses diverse models and methodologies including mouse models and cell culture. She also collaborates with surgeons within the Division of Laryngology to obtain human tissue samples from patients with a wide variety of voice disorders.

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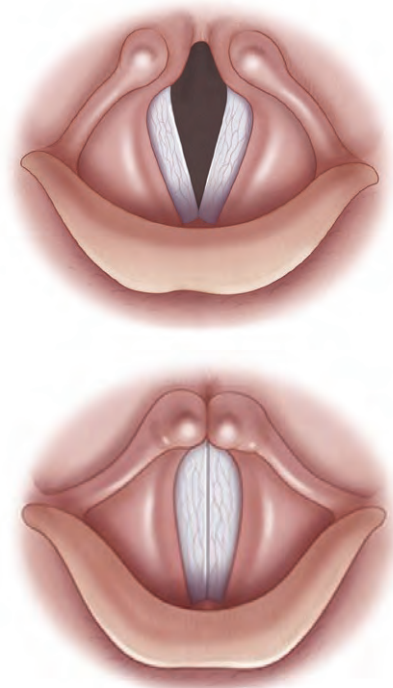
*The Laryngeal Research Laboratory at Stanford is one of only a few labs in the country that study the biology of the larynx, specifically the protective laryngeal epithelial and mucus barriers.*

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## Azficel-T: A Clinical Trial to Reverse Vocal Fold Scarring and Atrophy

The vocal folds consist of two adjacent tissues that vibrate, or “flutter,” against each other to produce sound when air is exhaled. Scar tissue on the vocal folds is caused by damage to the connective tissue layer of the vocal folds or lamina propria. Scarring reduces vocal fold elasticity and increases the air pressure required to vibrate the vocal folds, affecting voice tone, volume and effort. Vocal fold scarring can be caused by aging or excessive vocal exertion (as experienced by singers and public speakers) and is a frequent side effect of cancer, radiation therapy, and surgical trauma. Scar formation can also occur from smoking.

Vocal fold scarring is one of the most common yet difficult to treat voice disorders. Patients with vocal fold scar often experience severe and chronic voice impairment. According to Dr. Damrose, “People with scarring can have significantly distorted voices that seriously impact their ability to work and communicate. Many no longer become engaged in



Illustrations: Christine Galapp

conversations and social interactions. Diminished self-esteem may then cause further isolation.”

Current treatments—surgery, voice therapy, and injections or implants—only address symptoms and do not repair injured vocal folds. Azficel-T offers the potential to address the underlying cause of chronic or severe dysphonia by injecting the patient’s own fibroblasts directly into the lamina propria of the scarred vocal fold. Fibroblasts are harvested by collecting small skin biopsies from patients, separating the tissue into its component cells, then

expanding the fibroblast cells in culture. In this manner, each patient is treated with cells that were cultivated from his or her own dermal tissue (i.e., autologous).

The Stanford Division of Laryngology, along with the University of California, Los Angeles and NYU School of Medicine, are concluding a Phase 2 clinical trial evaluating the efficacy of autologous fibroblasts in the treatment of dysphonia. It is hoped that the successful conclusion of this trial will allow us to proceed with further investigations into this novel treatment method.

## Success Stories

### Innovative Larynx Cancer Treatment Saves Patients’ Voices

Jerry Young was diagnosed with larynx cancer—a squamous cell carcinoma, small and at an early stage. But even after radiation treatment, the cancer remained. After a friend recommended he see a physician at Stanford, he met with Dr. Damrose, one of the few doctors nationwide who do a precision removal of laryngeal cancer. Dr. Damrose excised the part of Young’s larynx where the cancer was. He essentially closed the gap by connecting the two main supports of the larynx, the cricoid cartilage and the hyoid bone. Instead of air vibrating through the normal vocal folds, it vibrates with the help of cartilage and muscle rotated into the reconstructed larynx, allowing for a human voice instead of a robotic one. The procedure is called a supracricoid laryngectomy with cricohyoidoepiglottopexy.

Cancer of the larynx is the most commonly diagnosed head and neck cancer—with between 10,000 and 12,000 new cases every year in the U.S.

“Any surgery in these tight quarters must be done precisely. One millimeter too far one way, and you’ve cut out an important nerve to speak. Too far the other way and you’ve left cancer behind, or your patient will never swallow again,” says Dr. Damrose of the voice-sparing surgery he performed on Young.

Developed in the 1950s and popularized by French surgeons, the surgery Dr. Damrose performed on Young was not done in the U.S. until the 1990s. Dr. Damrose performs more than a dozen of these procedures every year and would like to see it more routinely offered to preserve more larynges.





# Otology and Neurotology

Solving the Most Complex Ear Problems



LEADING EDGE + COORDINATED CARE

Hearing and Balance Testing, Medical Diagnosis, Sophisticated Microsurgery, and Advanced Technology Rehabilitation All in an Integrated, Patient-Centered Care Environment

Stanford has long been a leader in the care of complex ear problems. To better provide integrated and patient-centered care, in July 2014 we opened the Stanford Ear Institute (SEI) in an elegant new building custom designed for ear care with the finest in modern technology. The Institute is a joint effort, involving the Stanford School of Medicine, the Stanford Hospital, and the Lucile Packard Children's Hospital Stanford. Here, Stanford provides specialized, multidisciplinary care for a wide variety of ear and skull base disorders including hearing loss, infections, skull base tumors, and balance disorders. The state-of-the-art clinical facilities make up an integrated environment for the care of adults and children, including medical and surgical consultation, auditory testing, hearing device consultation and fitting, cochlear implant care, aural rehabilitation, balance testing, and physical therapy.

The Children's Hearing Center at the Stanford Ear Institute provides a full range of services for children with hearing problems from birth to 21 years of age. With a multidisciplinary, family-centered approach, our team of surgeons, pediatric audiologists, speech pathologists, and educational specialists diagnose and treat the entire spectrum of hearing conditions in newborns, infants, and children.

Our Otology and Neurotology Division is led by Chief Nikolas Blevins, MD, and a team of otologic surgeons and clinicians. Dr. Blevins, Robert Jackler, MD, and John Oghalai, MD, along with medical otologists John Shinn, MD, and George Shorago, MD, see most adult patients. Matthew Fitzgerald, PhD, Chief of Audiology, oversees a large team of audiologists who provide diagnostic and rehabilitative services. The Children's Hearing Center, lead by Dr. Oghalai, includes Kay Chang, MD, Alan Cheng, MD, and Dr. Blevins.



Otology and Neurotology
FACTS & FIGURES

Stanford Ear Institute (SEI) opened in

July 2014

A superb new clinical facility emphasizing integrated, patient-centered hearing and balance health care



8 ear specialists

provide sophisticated care for ear problems from the most complex to the ordinary

One of the premier ACGME-accredited

otology and neurotology fellowships worldwide

Audiology and hearing devices emphasize the latest of technology

One of the largest series of ear tumor cases in the world



Stanford Initiative to Cure Hearing Loss (SICHL)

created in 2006 as a major philanthropic focus

## Educating Ear Specialists From Around the World

Committed to training the next generation of leaders in the field, the SEI trains Stanford otolaryngology residents, neurotology fellows, medical students, and audiological interns. The SEI also hosts many international visiting physician observers who come to learn advanced methods of diagnosis and treatment. To help educate future ear surgeons, the SEI includes the 12-station Rodney Perkins Microsurgery Laboratory and Simulation Center, which offers both traditional and virtual microsurgery training.

This year, the Stanford Otology Course enters its 29th year. This biannual course, created by department chair Dr. Jackler in 1987, has trained thousands of participants, including surgeons, audiologists, and other clinicians from

around the globe in the latest advances in the field. The three-day course is one of the most highly regarded and longest-running program of its type in the world.



## Pioneering the Treatment of Pediatric Hearing Disorders

For hearing disorders in children, the earlier they are diagnosed and treated, the better.



*One out of every  
1,000 children is born deaf.*

According to Dr. Oghalai, who leads the Stanford Children's Hearing Center, "The isolation from society and learning that occur in patients with untreated hearing loss leads to developmental delays. It is critically important to diagnose and treat hearing loss as quickly as possible."

Here are some of the innovative programs from the Division of Otology and Neurotology aimed at bringing hearing options to children as quickly and effectively as possible:

### Expanding the Role for Cochlear Implantation

For children with hearing loss who gained little or no benefit from hearing aids, cochlear implantation can be considered. Having pioneered cochlear implants in the mid-1960s, Stanford remains at the leading edge of cochlear implantation—including the use of techniques and electrodes that have the potential to preserve residual acoustic hearing.

These neural prostheses bypass the non-functioning inner ear to stimulate the nerve of hearing directly. In doing so, an implant can potentially restore useful hearing and significantly increase an individual's ability to communicate. With cochlear implantation, together with the use of hearing aids and other implantable devices, it is now possible for deaf children to gain access to sound and use listening and spoken language as their primary means of communication. Children with such devices have unprecedented access to activities previously unattainable. It is expected that children born without hearing today, who are diagnosed early, and receive appropriate implantation and early educational services, can attend mainstream schools and enjoy the same activities and opportunities as their hearing peers.

The role of cochlear implantation in children with multiple medical and cognitive issues has yet to be clearly defined. Many children with severe hearing loss have coexisting conditions that may limit expectations for language development. Currently, there is little compelling evidence supporting the idea that cochlear implantation provides benefit to children that don't have the cognitive potential to develop normal speech and language. An ongoing multi-institutional, National Institutes of Health (NIH) funded clinical trial led by Dr. Oghalai is poised to bring some

clarity to this issue. The hypothesis is that development and quality of life will improve more in deaf children with developmental delays when treated with a cochlear implant compared to those treated with hearing aids. To test this hypothesis, we are performing a prospective, randomized clinical trial to answer the question of which intervention provides more benefit to this population of children using validated, norm-referenced tests. If our hypothesis is correct and cochlear implants significantly improve development and quality of life in deaf children with developmental delays, our study will provide essential evidence to optimize the hearing care of this population.

### **The Magic of Teletherapy— Making Rehab Accessible to All**

Cochlear implantation is only a step in providing listening and spoken language to children with hearing loss. Even children who are ideal medical candidates for implantation will not benefit from the device if they do not receive educational services to enable them to make sense of the new sensations the implant provides. Such services are crucial, because the first three years of a child’s life is a critical time for the development of speech and language. What happens during this time will have a significant impact on that child’s ability to benefit from listening and spoken language. Unfortunately, many deaf children and their families lack access to vital educational services during this critical period. In particular, children in remote locations and those facing socioeconomic challenges are most at risk for missing the life-changing hearing restoration that an implant can provide.

The Stanford Department of Otolaryngology, in partnership with the Weingarten Children’s Center, a recognized national leader in education for children with hearing loss, is changing this situation. In true Silicon Valley fashion, it created the BabyTalk program to address these challenges and bring critical educational services to children and their families. By combining the latest technology advances with leading edge clinical support, the BabyTalk program provides teleconsultation and teletherapy to families of children with hearing loss from birth to 3 years of age. Making use of commercially available tablet computer technology, the

BabyTalk program links families of deaf children and a team of experienced highly specialized clinicians, including audiologists, teachers for the deaf, social workers, and speech pathologists. This new program is the first of its kind to provide such an integrated teletherapy opportunity for this population.

Explains Dr. Blevins, “A cochlear implant is a very different way of delivering sound, and it requires a very active environment—including the parents, the child, and an educational team—to get the most from it. This program offers life-changing opportunities for children and their families, and is reaching indigent and geographically isolated families that would not have had a chance to get a cochlear implant if they didn’t have exposure to this program.”

During the last year, more than 50 children went through the program. The results of a recent study examining child language development indicate that children enrolled in the BabyTalk Program exhibit encouraging improvements in objective measurements of pre-verbal auditory development. Study results were presented at the American Cochlear Implant Alliance Meeting in 2015. These highly promising results have led to an expansion of research efforts with the BabyTalk teletherapy program, including its effects on the parent-child dynamic, familial stress levels, and the home language environment.



## Jumpstarting a Community— the Listen to Me! Summer Institute

Now in its ninth year, the Listen to Me! Summer Institute is the result of a collaborative effort between the Stanford Department of Otolaryngology and the Baker Institute for Children. This is an intensive, one-week training program for children, families, and professionals to learn how to foster listening and spoken language development in children with cochlear implants.

Children participate in an auditory-oral class setting and receive daily listening and spoken language therapy sessions. Likewise, the parents participate in educational presentations, therapy and class observations, role-playing for implementing goals at home, and a parent-support group. And even the siblings get into the act. Those who have normal hearing participate in a summer conference experience designed just for them, including crafts, games, and outdoor activities.

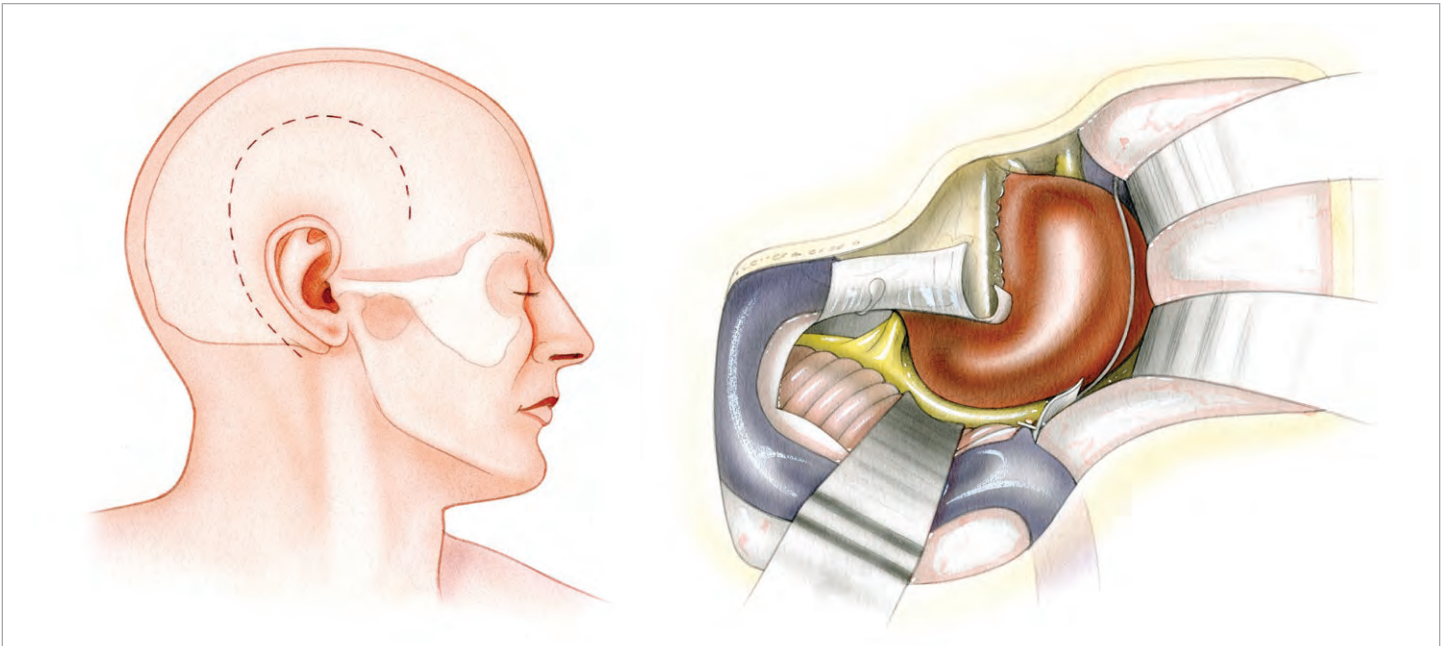
“Both this program and BabyTalk are not only geared toward the families affected by hearing loss, but also the hearing care providers in their communities. The more we can help those who are caring for these children, the better we can do

for these children, and all those who will need hearing care in the future,” explains Dr. Blevins. Therapists, audiologists, teachers, and administrators are encouraged to accompany their clients or come individually to participate in the experience and receive additional training.

The Listen to Me! program has become a model for other programs around the country as a means to ensure the maximal benefit from hearing restoration in children.

Data demonstrating the benefits of the Listen to Me! program was presented in 2015 at the meetings of the American Cochlear Implant Alliance, and the American Speech Language and Hearing Association. The data showed that 92% of families who completed this program either increased the amount of services their child received, improved the quality of their hearing technology, or both. Thus, the Listen to Me! program has had a profound effect on the everyday lives of the children and families who participate. We are currently using the Listen to Me! program not only as a launching point for further research efforts but also as a model for expansion of this highly impactful program to reach a larger number of families.





Illustrations: Christine Galapp

## Advances in Skull Base Tumors of the Ear and Temporal Bone

Stanford has earned a reputation for advances in skull base surgery, and has one of the premier otology and neurotology skull base surgery fellowships in the world. It leverages the talents of dedicated individuals from a broad range of specialties, including neurotologists, neurosurgeons, radiation oncologists, neuroradiologists, reconstructive surgeons, neurologists, and medical oncologists—all working together to provide integrated care for complex skull base tumors. In addition, the team cares for patients with congenital, inflammatory, infectious, or traumatic disorders of the complex anatomic region.

Departmental Chair, Robert Jackler, MD, is a world leader in the management of tumors of the ear, temporal bone, and postero-lateral cranial base. He has authored a number of seminal textbooks that have defined the scope and practice of neurotology, and has contributed a number of widely utilized innovations designed to enhance exposure of inaccessible intracranial tumors located adjacent to the brain stem. Since 1988, Dr. Jackler has directed a fellowship program in neurotology and skull base surgery that has trained over 20 academic leaders in the field at leading institutions around the world.

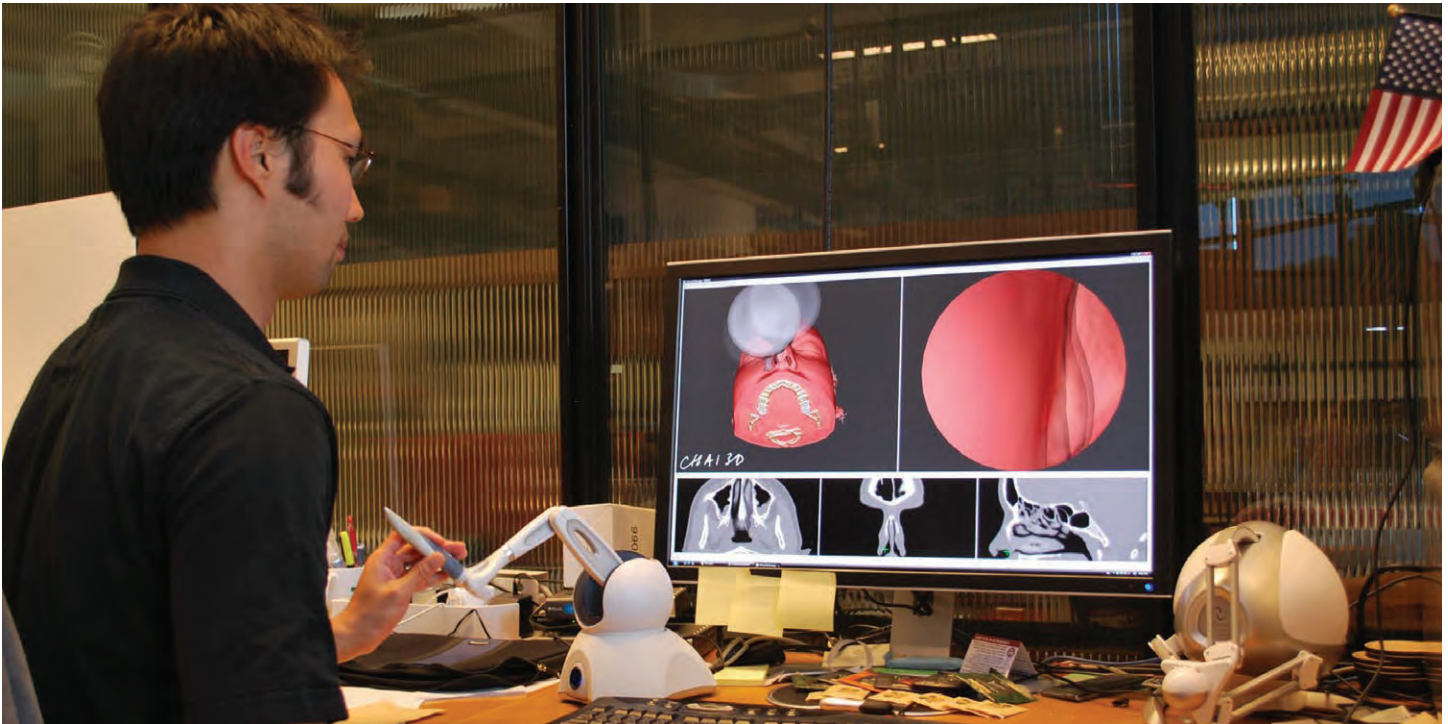
### An Evolving Specialty at Stanford for Complex Tumors

Skull base tumors present a particular challenge since they

reside in one of the most complex anatomic areas of the human body. They are located between the brain, vital vascular structures, and cranial nerves that are critical for function. The basic concept of skull base surgery is to approach the tumor in the least invasive manner possible—allowing optimal access for removal while preserving the most function possible. This usually involves the removal of skull base bone around these delicate structures to afford the access needed.

There is no question that microsurgery of skull base tumors is technically challenging, requiring not only the skill of an expert surgeon but specialized microscopes, and high-precision-powered instrumentation. Cranial nerve monitoring is used in skull base surgery. A neurophysiologist is present in the operating room throughout the surgery, and tracks the various nerves' health through continuous electrical monitoring. This optimizes the preservation of cranial nerves by facilitating gentle microdissection of the tumor off of the nerve.

In addition to microsurgical resection of tumors, the Stanford team offers the latest in radiosurgical management of appropriate tumors. This includes the use of the Cyberknife, which was invented at Stanford, and remains one of the most technologically advanced and flexible methods of delivering radiation treatments to the skull base.



## Dress Rehearsal for Surgery—Patient-Specific Virtual Reality Simulation

The Stanford Artificial Intelligence Laboratory created the first robotic arm in the 1960s and is continuing to achieve advancements in areas such as virtual reality. Increasingly, such advances are being applied to complex surgical procedures.

Operating in an area as complex and delicate as the skull base is a challenge. To better prepare a surgeon for what will be encountered during actual surgery, Stanford developed a virtual-reality environment for surgical rehearsal using a patient's preoperative imaging data.

The system, called CardinalSim, has been jointly developed by Dr. Blevins and Kenneth Salisbury, PhD, in the Stanford Department of Computer Science, and gives surgeons the opportunity to perform simulated dissections on a virtual representation of anatomy derived from clinical-imaging studies. By exploring relevant anatomic relationships in a safe environment, the surgeon can be better prepared for otherwise unexpected challenges, thereby minimizing risks. The system is intended to provide the opportunity for greater precision, efficiency, and ultimately improved clinical outcomes.

Stanford surgeons currently have access to high-resolution, multimodality, preoperative imaging data that can provide tremendous insights into what will be encountered during a planned procedure. Patient-specific rehearsal is intended to improve surgeons' ability to manipulate and interact with this data in a meaningful way, and provide access to a library of diverse cases to facilitate preparation for a variety of procedures. These advances are expected to bring measurable benefits to surgical procedures in multiple specialties.

The program blends CT and magnetic resonance imaging data to create a vivid three-dimensional model of the skull base, allowing the surgeon to practice removing tissues, to take a visual tour of the patient's anatomy. The use of haptic (touch) interfaces allows the surgeon to feel subtleties in a virtual model that may affect the course of an actual procedure. Recent validation studies have shown that the use of this system can improve a surgeon's confidence in approaching challenging portions of a procedure, a potentially critical element in improving surgical outcomes.

## Biological Cures for Inner Ear Hearing Loss

Our ability to communicate is at the core of what it means to be human, to share ideas, to enjoy friendship, to teach our children.

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*As German philosopher Immanuel Kant said,  
“Not seeing separates us from things;  
not hearing, from our fellow man.”*

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Helen Keller, who was both deaf and blind, had a unique perspective about hearing loss: “I am just as deaf as I am blind. The problems of deafness are deeper and more complex, if not more important, than those of blindness. Deafness is a much worse misfortune. For it means the loss of the most vital stimulus—the sound of the voice that brings language, sets thoughts astir, and keeps us in the intellectual company of man.”

Hearing loss is a huge problem: 5% of the world’s population and half of seniors over 70 have hearing loss that interferes with everyday activities. People are living longer today, and they want to live fulfilling and productive lives throughout, but hearing loss can make that challenging and often heart-breaking. How do people truly enjoy a restaurant dinner with family, an evening at theater, or the laughter of children if their hearing fails? Hearing loss is a major issue for children as well, affecting nearly one million children in the U.S. alone. A child’s hearing loss can have a significant impact on speech and language development and without intervention can have consequences for education as well.

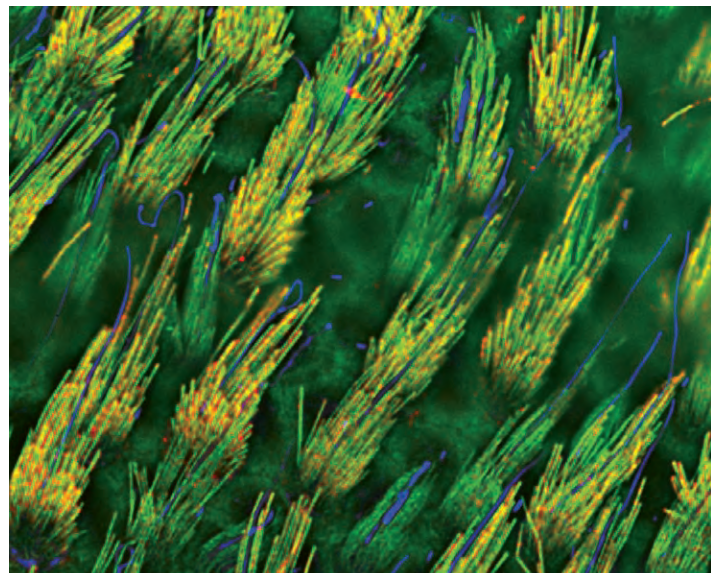
The Stanford Initiative to Cure Hearing Loss (SICHL) was founded to change that situation by inventing biological cures for hearing loss. SICHL is Stanford’s “moonshot to seek a cure for hearing loss,” and is a research initiative with immediate access to the advanced technologies available at Stanford University.

At Stanford, medical innovation is central to our history. More than 50 years ago, we played a pivotal role in the development of cochlear implantation, thanks to the

pioneering work of multidisciplinary teams lead by Blair Simmons, MD, and Robert White, PhD. In 1964, the first multichannel auditory implant was placed, providing deaf patients with an unprecedented access to sound. This invention was a collaboration among surgeons, engineers, basic scientists, and audiologists. Today, Stanford continues this tradition of innovation through collaboration. This persists as a central theme driving breakthroughs in the laboratory, as well as at the new Stanford Ear Institute, where a team of otologic surgeons and multidisciplinary specialists care for a wide range of complex ear problems.

### Imagine a World in Silence No More

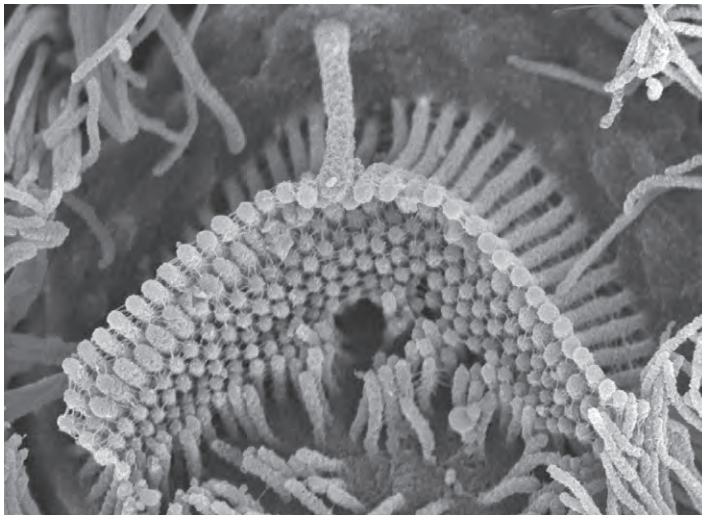
What if treatments that repair the damaged inner ear could restore lost hearing, quiet tinnitus, and improve balance? What if we could identify all of the hundreds of genes responsible for hearing loss, instead of only the relatively few that have been identified to date? What if we could identify the genes responsible for noise and drug susceptibilities that could instruct a person to avoid specific challenges to the inner ear in his or her life, thereby preventing early onset age-related hearing loss? And what if we could find a unifying approach to treat a broad spectrum of hearing disorders, including congenital, age-related, and drug- and noise-induced, and provide patient-tailored treatments for these different forms of hearing loss?



SICHL is a research initiative that will enable collaborative research to accelerate the development of novel cures. A simple example of this is our combined effort to broadly study the pathology of noise exposure in animals from molecular changes in cells, cochlear cytomorphology, cochlear anatomy, and cell and systems physiology. In-depth understanding of the pathology allows us to design novel methods to diagnose the precise location of a cochlear defect and to generate tools for repair. Having a team of basic scientists and clinician/scientists allows us to translate results from animal models directly to humans.

Eleven world-class researchers at the Stanford School of Medicine, Otolaryngology – Head & Neck Surgery Department lead the initiative.

Rapid advances in bioscience and technology, many of which originated at Stanford, make it realistic to envision a cure for hearing loss within the foreseeable future. In laboratory animals, we can now regenerate inner ear hair cells, a tantalizing discovery, which we are working hard to adapt for human benefit.



The inner ear is a favorable site for regeneration. Most solid organs that have failed become a collapsed lump of scar. In the deaf inner ear, the architecture is usually preserved. The elegant cochlear spiral and the auditory nerve remain viable, often with only a specific population of hair cells missing.

Major strides have been made in regenerating hair cells in the mouse and connecting them to the hearing nerve.

The challenge before us is to refine the method and make it safe and effective in humans.

“Noise exposure and modern drugs such as chemotherapy or certain antibiotics are toxic to our hearing. These environmental exposures, in combination with the effects of aging and genetic disposition, are causing a worldwide pandemic of hearing loss,” says Stefan Heller, PhD.

### **SICHL’s Research Focus**

A major focus of SICHL is to support teamwork and to tackle projects that can directly lead to advanced patient care. We are motivated to take on the high-risk/high-impact questions that go beyond the traditional methods of incremental advances. Such approaches are currently very rarely supported by government funding agencies. Therefore, SICHL support is vital to enable these collaborative projects that take advantage of each researcher’s particular expertise, thereby producing successes much greater than those possible from the sum of individual effort. This synergistic approach allows us to address the most critical questions in the field with the highest innovative spirit possible.

As an example, SICHL research is helping us understand how a person’s DNA plays a role in determining susceptibility to chronic noise exposure. Similarly, this understanding also provides clues as to why some people will not lose their hearing even when working in a loud-noise environment for most of their lives. Knowing the genetic mechanisms of “susceptible ears” and also the genetic circumstances that lead to “robust ears” is important for development of drugs that prevent hearing loss.

Another SICHL-supported project has helped define the role that nerves and other supporting cells in the cochlea play in the development of hearing loss. Contrary to conventional thought, we are finding that these cells may actually be affected before sensory hair cells are lost. Drugs that stabilize these other structures of the cochlea offer hope in the treatment of individuals at risk for hearing loss. Finding ways to keep these cells healthy may prove a valuable pathway to prevent hearing loss from noise, toxins, or other injury—in ways not possible by focusing on the sensory hair cells alone. This may also make





Linda A. Cicero / Stanford University News Service

cochlear implants work better and could reduce age-related hearing loss. Anthony Ricci, PhD, a SICHL researcher with worldwide-recognized expertise in hair cell physiology, is a crucial collaborator in this, assessing whether preventions and interventions are truly effective. Dr. Oghalai, whose expertise is focused on systems-level assessment (i.e., measuring hearing and perception in living animals), makes it possible to demonstrate efficacy of novel therapeutic approaches.

A collaboration between Drs. Ricci and Cheng has yielded insights to prevent antibiotic-related inner ear damage in millions of future patients. Their work has developed novel aminoglycoside antibiotics that lack the side effect of damaging the inner ear, and result in hearing loss and balance impairment in many exposed individuals. If these drugs become available worldwide as planned, they will fundamentally alter the risk of this lifesaving therapy and improve the lives of millions.

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*Cochlear hair cell regeneration  
is one of the long-term goals for finding  
a biological cure for hearing loss.*

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Our multipronged SICHL-supported approach aims to characterize the cells in the organ of Corti that remain after hair cell loss and to find ways to stimulate these cells to generate new hair cells. Approaches include the stimulation of known signaling pathways (for which drugs already exist) and recapitulation of embryonic development (to naturally restore/rejuvenate the inner ear). In parallel, we are studying the mechanisms of how the damaged mammalian vestibular system replaces lost hair cells as well as how the chicken cochlea manages to efficiently regenerate lost hair cells. The knowledge gained from these research initiatives will be the basis for novel application in human disease.

Making sensory hair cells from stem cells has been a major breakthrough at Stanford. We now know that it is possible to generate new hair cells in a culture dish. Over the next decade, we will work on translating this knowledge toward new drugs and safe and efficient transplantation into damaged inner ears. We are certainly not at a point where this work has reached the clinic yet, but we are determined to achieve this goal to provide safe and efficient opportunities to cure hearing loss.

Concurrent with basic research, SICHL scientists are exploring practical ways to deliver cells, drugs, genes, and diagnosis devices such as microendoscopes into the inner ear. In the gene therapy area, genetic testing has shown that 70% of the most common forms of hearing loss are caused by mutations in only three genes. Using this knowledge, it is reasonable to develop gene therapy vectors to override the defective gene with an intact healthy one. This type of research focuses directly on patients with genetic causes of hearing loss. Our researchers work on generating disease

models from patient-derived stem cells that can be used in the laboratory to develop safe and effective gene therapy treatments. The goal is to translate these findings into the first clinical trials within a time frame of 10 years.

Explains Dr. Heller, “Progress will be achieved through partnerships and collaboration, coupled with breakthrough science and brilliant problem-solving. The back-and-forth dynamic of translational medicine has one concentrated focus: to find a way to cure hearing loss.”

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*“If we can better understand the basic mechanisms of the inner ear and regenerate it—that will open up the next revolution in hearing for the next 40 years, just as the cochlear implant did in the 1960s.”—Nikolas Blevins, MD*

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## Better Understanding the Function of the Auditory System Through Minimally Invasive Techniques

### Improving Outcomes in Deaf Children with Cochlear Implants

What if we had a clearer picture of how auditory nerve fibers are being stimulated with cochlear implants? A functional MRI could provide the answers, yet cochlear implants are magnetic and can't go through an MRI, and even if they could, it would require children to be sedated and would not be feasible for regular and repeat investigation. With that in mind, Dr. Oghalai began research into the use of Near-Infrared Spectroscopy (NIRS) to image activity in the auditory cortex of children with cochlear implants.

NIRS measures changes in blood-oxygen levels in tissue, similar to an MRI, but NIRS works by beaming light into the head and measuring how much comes back out. When a part of the brain is used, more oxygenated blood flows to that region and light is absorbed differently. By mapping those differences, NIRS can detect which part of the brain is activated.

For cochlear implants, the programming process can be lengthy, and particularly challenging for young children born deaf—taking sometimes months to complete and causing the child to miss valuable learning time. So Dr. Oghalai

envisions a scenario where the device could be mapped correctly from the time that it is activated. NIRS could be used at every visit as a diagnostic tool for the audiologist to improve care. It would enable an audiologist or implant center to gain immediate access to specific data concerning the stimulation of the auditory nerve in the office and while a child is awake and listening to spoken language.

With funding from the Dana Foundation and the NIH, Dr. Oghalai is now conducting a follow-up study using the higher-resolution NIRS machine. It has nearly 300 channels

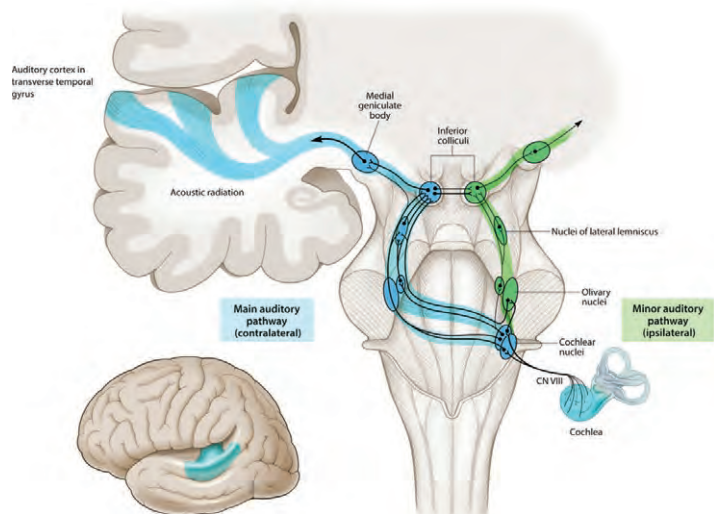


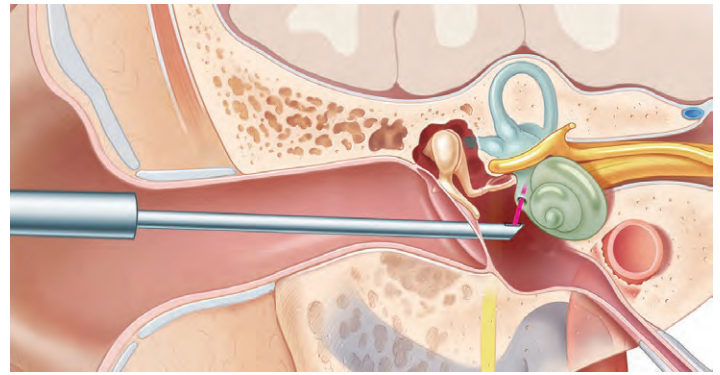
Illustration: Christine Galapp

versus four in the previous one. According to Dr. Oghalai, “This means we can see which nerves are being stimulated with much greater precision. It allows us to not only see whether the auditory cortex as a whole is being activated, but which specific part of it is being activated.” The goal of this research is to develop near-infrared spectroscopy neuroimaging into a valid and reliable clinical tool to aid the care of children who hear through a cochlear implant. This technique is expected to enhance the ability of a cochlear implant team to program a child’s device.

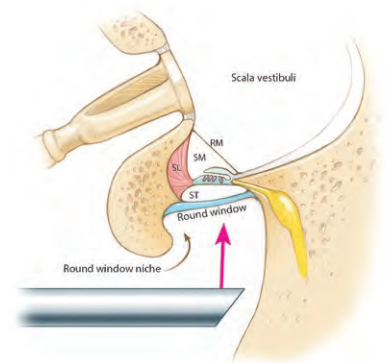
### **In Vivo Studies of Cochlear Function Using Optical Coherence Tomography**

The Oghalai Laboratory, funded by two NIH grants, is studying cochlear physiology in animal models. We have developed an approach to use Optical Coherence Tomography (OCT) technology to not only image the interior of the cochlea but also measure how it responds to sound stimulation. This is all non-invasive, permitting an unprecedented level of detail describing how the tissues within the inner ear process sound. This fundamental research is designed to describe how the cochlea works in states of health and disease, and hopefully will lead to improved sound processing strategies to make hearing aids more effective. Some of this work has recently been published in the *Proceedings of the National Academy of Sciences* and in the *Journal of Neuroscience*.

Furthermore, Dr. Oghalai has received a Birdseed Grant from the Stanford University office of Technology and Licensing. “The objective of this research,” according to



Dr. Oghalai, “is to translate OCT technology that we have developed to study the mouse cochlea into a novel biotech product that addresses a currently unmet clinical need. We are performing feasibility first-in-human trials of a device we designed for diagnostic imaging of the human inner ear. Hopefully, this groundbreaking application of technology will substantially improve our ability to diagnose and treat disorders of the ear.”



Illustrations: Christine Galapp

The level of detail within the cochlea that we can now image is roughly two orders of magnitude better than what is currently available with the latest MRI or CT techniques. The goal is to be able to identify why any given patient that comes to clinic has hearing loss, and use this information to guide management using regenerative strategies that are in active development.

## **A Loss of Hearing Journey: From Neuroblastoma to Cochlear Implant With Hearing Preservation. Next Stop—College**

A young child, saved from cancer, was left with progressive severe hearing loss. The story began on Christmas Eve 2003 when a family in Arizona had their 2-year-old son diagnosed with neuroblastoma, a rare form of pediatric malignancy. Fortunately he survived, but only after many rounds of chemotherapy, surgery, a stem cell transplant, and monoclonal antibody therapy. During his stem cell transplant, he received high doses of antibiotics as well as powerful

chemotherapy. He suffered very significant hearing loss—the unfortunate side effect from this lifesaving treatment.

His parents spared no effort to support him in dealing with his hearing deficits. His loss was initially moderate, affecting primarily the high frequencies. With the use of hearing aids, and educational support, he developed language appropriately and attended mainstream schools.

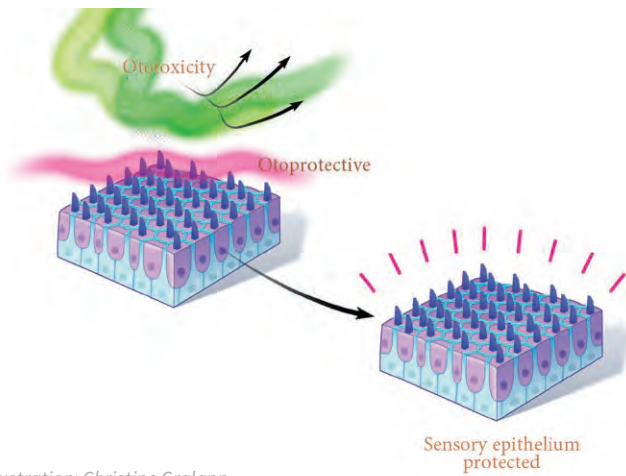


Illustration: Christine Gralapp

Then, in seventh grade, his hearing seemed to suddenly deteriorate. An excellent and motivated student, he found it difficult to follow what teachers and fellow students were saying. His grades and social interactions suffered. Getting through the day became exhausting with the effort needed to keep up. Although there was still some hearing in the low frequencies, the loss of the high frequencies had become profound—leaving him with no way to differentiate sounds that carry speech information. The hearing loss and resulting isolation were interfering with daily activities, and deeply affecting his normally happy confident nature.

His parents reflect on this difficult time: “Our son Bryce went from being a good student and happy social child to having poor grades and sadness. We had tutors in math, english, history, and Spanish but they were of little help. He became more disinterested at school and argumentative at home. He missed so much content in communications that he was frustrated and increasingly isolated. We felt so sorry for our seventh grader. It was a very difficult time for our family.”

At age 14, it was clear that something needed to be done. He was seen at the Stanford Ear Institute, where he was found to be a candidate for hybrid cochlear implantation. With this procedure, the implant could restore high-

frequency hearing while providing the potential to retain the remaining low-frequency acoustic hearing.

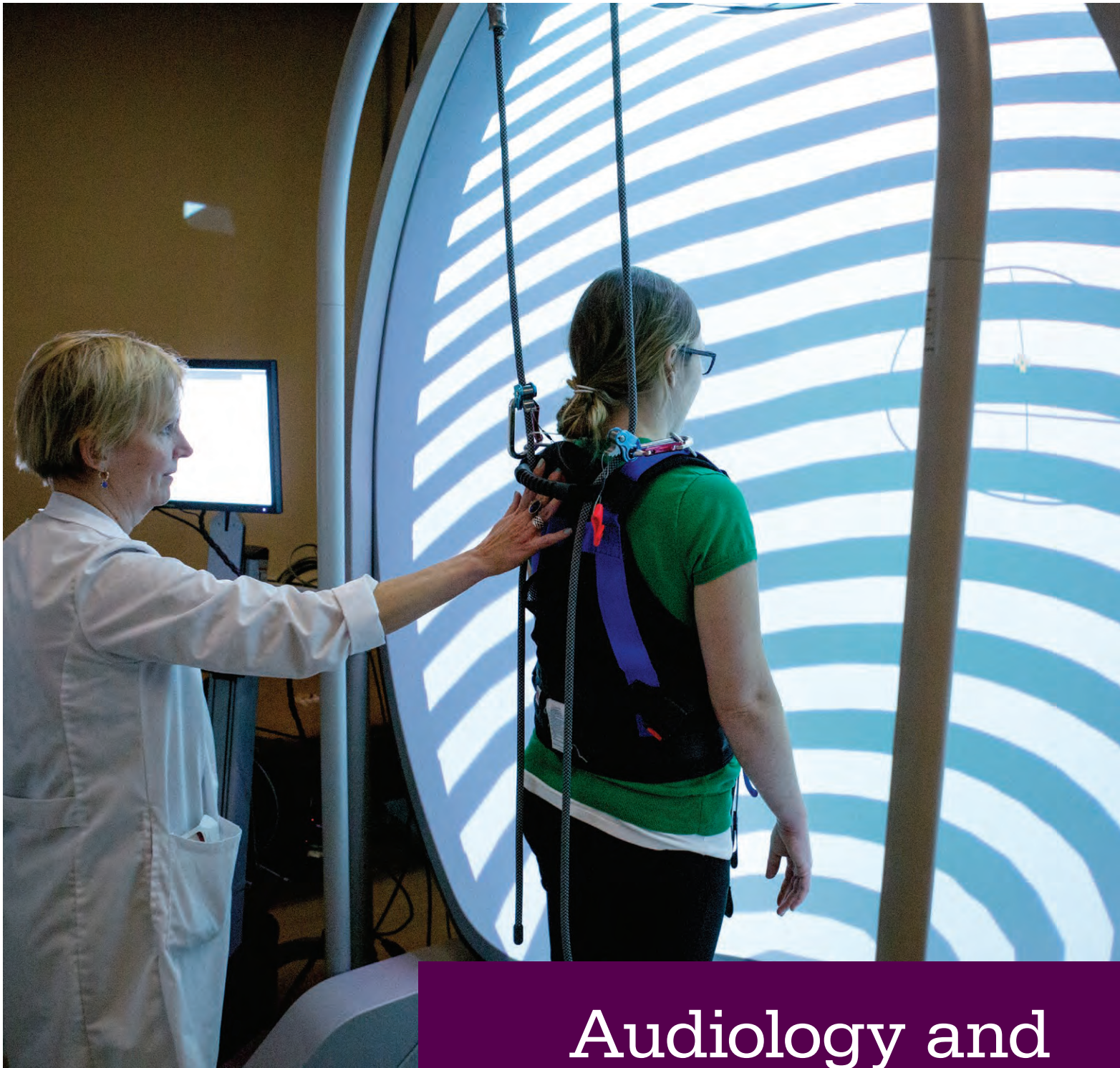
Dr. Blevins performed the surgery. Within weeks, there was a striking improvement. The new sound provided by the device together with his remaining hearing dramatically improved his ability to connect with the world around him. Today, he is back on track with his studies, enjoying life, and looking forward to college. Both he and his family are strong supporters of the Stanford Initiative to Cure Hearing Loss. He and his family look forward to a time when additional hearing restoration will be an option through regenerative methods.

According to the patient’s mother and father, “The implant made a huge difference in that Bryce could understand conversations. He had largely relied on reading lips after his hearing collapsed and suddenly he could hear. Bryce commented that it was a great relief to know that he would not remain deaf, and could participate in the world he had grown up in. He quickly returned to his normal outgoing positive personality and now is spending time with his friends again. The frustrations of not being able to hear are a thing of the past. Bryce feels he can hear much better in a noisy environment with his implant than he ever could with his hearing aids. His processor is an all-important part of his life.”

“We are so thankful to Dr. Blevins and his team. The hybrid implant has made all the difference for our son. We envision a day when our son’s remaining hearing loss can be corrected by the work being done by the Stanford research initiative.”

Stories like this also motivate the Stanford otology team to find means to prevent hearing loss from chemotherapy in the future. Thanks to research underway by Dr. Chang in the Pediatric Otolaryngology Division, hearing loss from ototoxic drugs may be preventable. Dr. Chang is actively involved in several human clinical trials investigating otoprotective agents that may drastically decrease the number of children developing hearing loss after chemotherapy.

*The Division is pleased to announce its recent expansion into the South Bay, with the addition of Hamed Sajjadi, MD, into Stanford’s University HealthCare Alliance. Dr. Sajjadi brings his skill and experience as a board-certified neurotologist to the San Jose community.*



# Audiology and Hearing Devices

Advancing the Diagnosis, Rehabilitation,  
and Language Development of Patients  
With Hearing Loss

## Audiology and Hearing Devices **FACTS & FIGURES**



Stanford has four cochlear implant surgeons in the Audiology and Hearing Devices Division

**ESTIMATED**  
**50%**  
**AMERICANS**

Aged 75+ have age-related hearing loss



Open-ear hearing aids were introduced in

**2005**

Rate of hearing decline between men and women

**20yr**

**DIFFERENCE**

An 80-year-old man usually has the hearing of an 80-year-old man, but an 80-year-old woman may have the hearing of a 60-year-old man

Sources: Popelka GR. *Hearing, Hearing Loss, and Current Technology: Notes from the Doc Talks*. Stanford Health Library. February 20, 2014.

How do individuals adapt to hearing loss? What can be done to facilitate this process? The quest to answer these key questions drives the activities of Stanford Audiology and Hearing Devices.

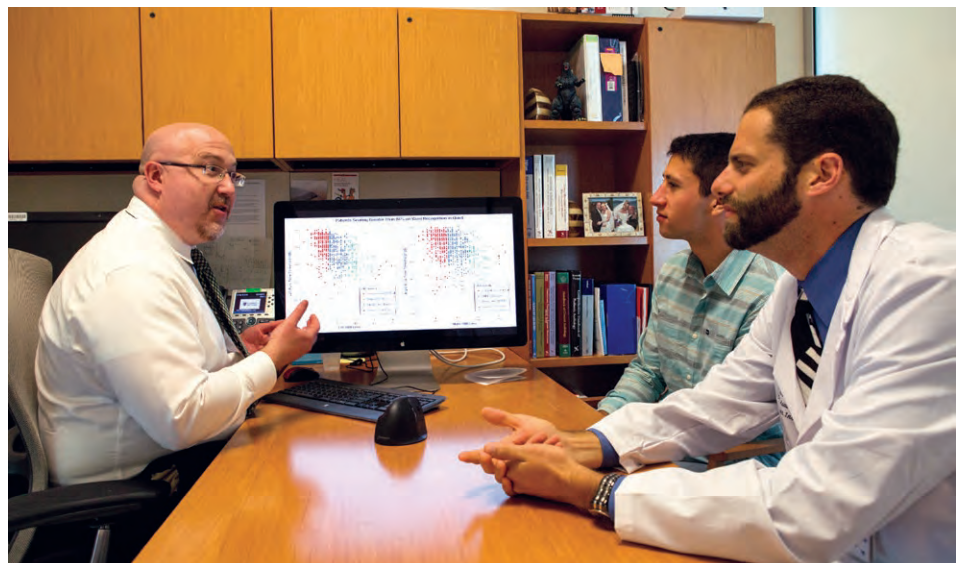
Our comprehensive audiologic practice encompasses leading edge, coordinated care regimens; research programs; diagnostic expertise; and professional and patient education efforts. All our initiatives share three key objectives:

- Accurate diagnosis of hearing loss
- Management of hearing loss through the proper fitting of cochlear implants and hearing aids, and through rehabilitation programs
- Optimization of language development in children with hearing loss

In addition to furthering the understanding of disorders along the ear-to-brain auditory pathway, we also focus on the auditory system's ability to maintain balance and prevent dizziness.

The comprehensive capabilities of our division address complete diagnosis and management of hearing and vestibular problems. Our diagnostic and treatment services encompass all physiological and behavioral measures related to hearing organs and vestibular function. Our rehabilitative expertise also extends to full-service dispensing of assistive listening devices, including the most advanced digital hearing aids and cochlear implants.

Then we closely track outcomes in both small- and large-scale studies that form the foundation of our division's academic and educational endeavors.



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*“We can really make a difference in people’s lives. That is immensely rewarding.”—Matthew B. Fitzgerald, PhD*

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## Evolving Entrenched Practices to Enhance Speech Understanding and Language Development

At Stanford Audiology and Hearing Devices, we continually ask ourselves one key question that ultimately sustains our activities: What can we do on a diagnostic and rehabilitative basis to assess and improve the ability of individuals to understand speech? In pursuit of this question, we address a number of fundamental issues. These range from translational research projects that investigate patterns of auditory perceptual learning to reassessment of the traditional audiologic test battery.

In one such translational study of perceptual learning, we are examining whether patterns of auditory learning in individuals with hearing loss differ from those in individuals with normal hearing. Such investigations are fascinating on a purely scientific level, but they also reflect a desire to develop clinical applications that impact the lives of patients and their families. Our work embodies the essence of translational research—designed to progress from lab to bedside to becoming the standard of care for the audiology community at large.

Another focus of the division is to take a leading role in evaluating clinical practices that have been in place for decades. For example, a staple of audio-

logic testing for over 50 years has been the assessment of speech understanding *speech in quiet*. In contrast, both professionals and patients know that understanding *speech in noise* is what truly challenges people with hearing loss. Thus, we have added *speech in noise (SIN)* testing to our audiologic protocols.

Our goal is to modernize aspects of the basic audiologic test battery with the intent of making it more sensitive on a diagnostic and rehabilitative basis. Our ability to quickly adapt and conduct large-scale research is an important and unique attribute of the Audiology and Hearing Devices at Stanford. This capacity, combined with our translational research efforts, speaks to our goal to shape and improve clinical practice not only at Stanford, but worldwide.

### Collaborating Closely With Colleagues, Other Specialties, and One More Vital Partner: Patients' Families

Within our division, our physicians, audiologists, and allied professionals work closely as a team to enhance patient outcomes. In some instances, these collaborations occur at the Stanford Ear Institute itself, where speech pathologists and audiologists work with children and adults with hearing loss to maximize speech and language outcomes. Our team

even includes a full-time physical therapist who focuses on vestibular rehabilitation; this is a rarity in an audiology division and a valuable contribution to helping us maintain continuity of excellent care.

Our team collaborates with other divisions of the Department of Otolaryngology as well. For example, with our colleagues in Otology and Neurotology and the staff at the Weingarten Childrens' Center, we help implement innovative programs such as BabyTalk. This popular program offers teletherapy in both English and Spanish focused on the development of listening and spoken language skills in children with hearing loss. Parents and children consult directly with audiologists, speech-language pathologists, deaf educators, and social workers via customized teletherapy sessions, virtually bringing a center of excellence right to the comfort and convenience of each family's home.

We also work with members of the Psychology Department at Stanford, whether in clinical endeavors with patients who suffer from tinnitus, or in research efforts into language

development in children with hearing loss. Additional collaborators include faculty at Stanford's Center for Computer Research in Music and Acoustics, a multidisciplinary facility where our researchers collaborate with specialists employing the latest state-of-the-art digital technology.

Ultimately, our most important collaborator may well be the family or spouse of each patient we treat. Hearing loss has a dramatic impact not only on the patient, but also on family members. Moreover, these family members play a remarkable role in enhancing patient outcomes, whether it's parents learning to create a rich environment for developing language, or spouses better understanding the challenges that many noisy environments have for persons with hearing loss. Ultimately, family members play a vital role in the treatment of hearing loss.

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*“We love it when families and spouses are here.  
The more family, the better.”  
—Matthew B. Fitzgerald, PhD*

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RESEARCH

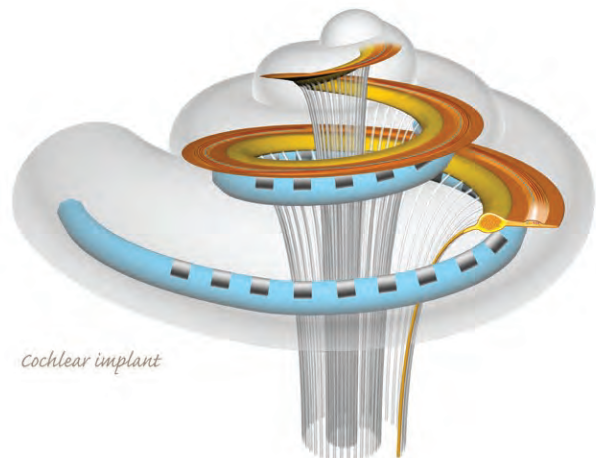
## Discovering New Answers to Age-Old Questions About Outcomes and Perceptual Learning

Why do outcomes with assistive devices such as cochlear implants vary so widely from patient to patient? Why do some individuals adapt easily while others struggle?

These questions point to a vital area of our research. We are studying whether we can facilitate adaptation and improve outcomes by using new procedures to custom-fit the implant to the patient, rather than relying on a “one size fits all” approach.

A second vital area of study is on fundamental issues of perceptual learning. To what extent can people adapt to an altered auditory signal? Do people with hearing loss learn differently than those with normal hearing? If so, what are the implications for our patients, for us as professionals, and for our education system?

These are difficult questions—the type of complex challenges we welcome at Stanford Audiology and Hearing Devices.



Cochlear implant

Illustration: Christine Galapp





## Educating Audiologists and Physicians to Evolve Their Pathways and Protocols

Modifying the ways that audiologists and physicians practice requires extensive education. For that reason, to complement our publication and presentation strategy, we are actively involved in the educational mission of Stanford by training future audiologists.

We currently host two audiology externs who come to Stanford for a final year of clinical training. These students come from all over the United States to hone their skills at the Stanford Ear Institute and to participate in research within the Division of Audiology. In addition, we train beginning students from neighboring audiology programs. Thus, education is wrapped into everyday clinical practice at Stanford.

We also strive to develop templates and protocols for diagnostic and rehabilitative practice that are designed for easy adoption by audiology centers across America and worldwide.

Finally, along with our colleagues in Otolaryngology and Neurology, we help implement the Listen to Me! Summer Institute. This intensive one-week training program teaches professionals, plus children and families, how to foster listening and spoken language development with cochlear implants.

Stanford Audiology and Hearing Devices leads both by example—as an early adopter of the practices we help pioneer—and by instruction.





# Facial Plastic and Reconstructive Surgery

A Center of Excellence for Aesthetic and  
Functional Restorative Surgery of the Face

## Enhancing Care, Advancing Our Specialty, Delivering Superb Clinical Service

The human face is our interface with the world around us. Our expressions communicate feelings of joy, sadness, compassion, and even love. Maintaining a healthy, pleasing face is important to us all. Stanford's Facial Plastic and Reconstructive Surgery Division, under the leadership of Sam P. Most, MD, cares for a complete range of functional and cosmetic issues related to facial structure.

Functional procedures include repair of facial fractures and soft tissue injuries. Dr. Most is highly skilled at repair of defects following treatment of facial skin cancers. His expertise also encompasses care and rehabilitation of facial paralysis, and amelioration of facial spasm.

Cosmetic services include procedures to rejuvenate the aging face, such as facelift, forehead lift, eyelid surgery, and a procedure for which Dr. Most is world renowned: rhinoplasty—reshaping of the nose. Together with surgeons from Stanford Sinus Center, we implement a two-team approach that allows correction of both aesthetic and functional aspects of nasal deformity.

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*“The work we do comes down to millimeters—both on the reconstructive side and the aesthetic side. We have very, very, high standards. We never accept anything less than perfection on the operating table.” —Sam P. Most, MD*

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The Facial Plastic and Reconstructive Surgery Division is truly a global center of excellence for aesthetic and functional facial surgery in an academic medical center. To fulfill our mission of improving patient care, advancing our specialty, and providing excellent clinical service, we develop leading-edge treatment programs, conduct critical research, and train our peers worldwide—all from our state-of-the-art facial plastic surgery clinic, opened in 2015 and optimally designed for both aesthetic elegance and sophisticated care.



## Facial Plastic and Reconstructive Surgery **FACTS & FIGURES**

Our new, state-of-the-art Facial Plastic and Reconstructive Surgery clinic opened in

**2015**



**1,000+**

Nasal reconstruction procedures performed to date

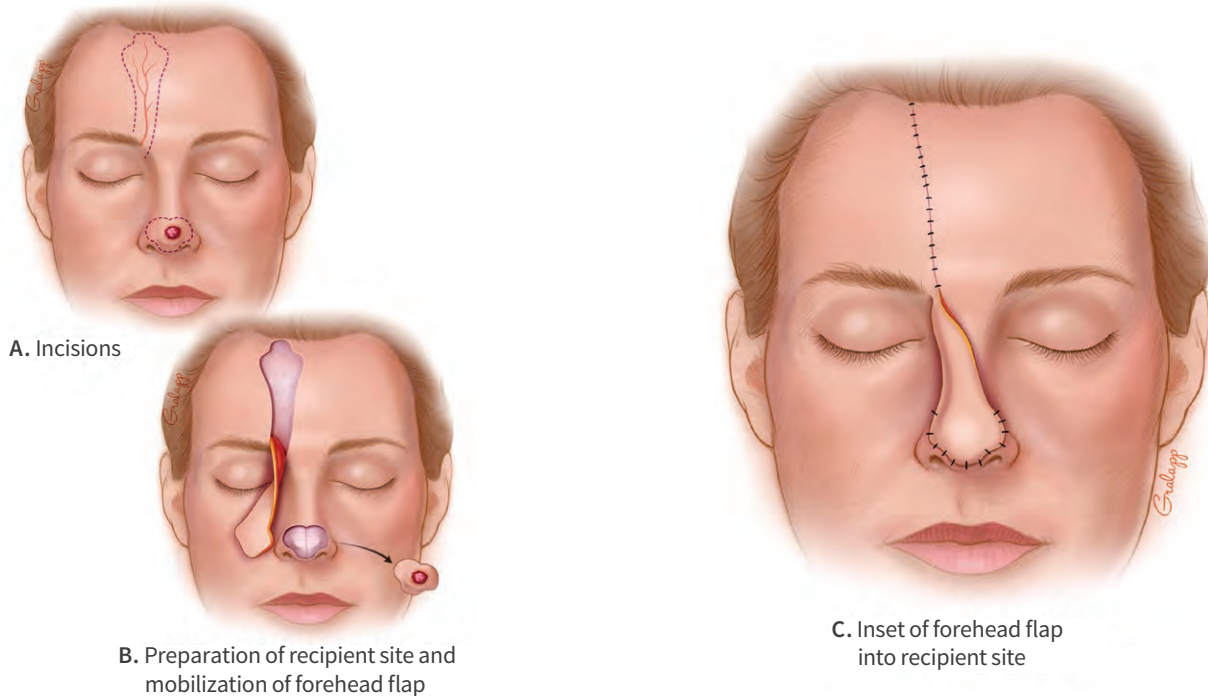
Our division is

**ONE OF FEWER THAN 50**

certified Facial Plastic Surgery fellowships in the U.S.



Treating facial deformities in Phnom Penh, Cambodia, since 2013



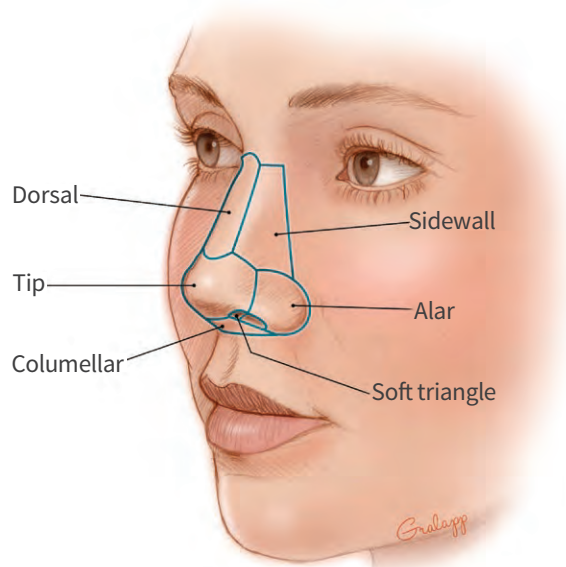
## The Most Demanding of Facial Reconstruction Surgeries

The Facial Plastic and Reconstructive Surgery Division excels in the forehead flap technique for reconstruction of a missing nose.

This is perhaps the most demanding of facial reconstruction surgeries, as we strive to optimize both form and function. After more than 1,000 nasal reconstructive procedures, we have refined the process of sculpting a living, three-dimensional structure with the biological properties, elasticity, and form of a nose. Our outcomes couldn't be more obvious: "It's as plain as the nose on your face." Of course, beyond appearing natural, the new nose must function as well, which makes the surgery even more technically challenging. The procedure is art. It is science. It is engineering. It must meet a high standard for both aesthetic and functional outcome.

The forehead flap procedure was pioneered hundreds of years ago. Yet new innovations continue to drive the progression of the technique. For example, among the most notable recent advances is the understanding of the nine aesthetic subunits of the nose, the areas of light and shadow that we subconsciously perceive and that compose every single nose of the human race.

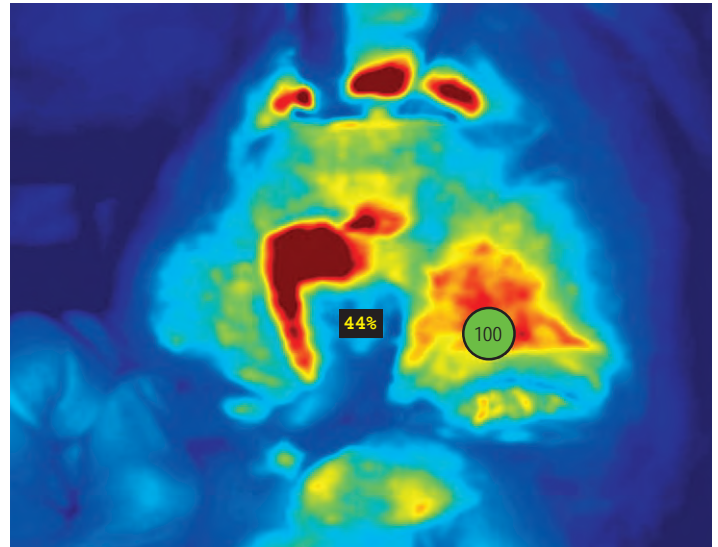
Our division understands the need to reconstruct individual subunits, align scar lines with them, and, as a result, make the scars less visible. It is a lengthy process. As Sam P. Most, MD, our division chief, states: "I tell my patients, 'It's a journey. And I'll be with you the whole time. We'll make lemonade out of lemons. We'll take a big bowl of lemons caused by the cancer removal, and we'll make something nice from it.'"



## “The Face Space”: Delivering Clinical Excellence in a Dedicated Center

We work in a state-of-the-art, ultra-modern space dedicated to facial plastic and reconstructive surgery. Our clinic features the latest technology, both for surgical performance and for surgical planning and recovery management. Our digital imaging capabilities enable us to optimize refinement of our technique and help our patients understand the procedures and targeted outcomes.

Surgery in our division—both reconstructive and aesthetic—is always a matter of millimeters. The procedures are complex. Patients have high expectations (or at least hopes), as do the physicians who refer their patients to us. We take pride in maintaining the highest standards of clinical service.



### RESEARCH

## Pioneering Facial Plastics Research and Fulfilling Our Academic Mission

### Reducing Recovery Time Following the Forehead Flap Procedure

The skin flap is a major cause of morbidity for patients—psychologically and socially. So if we can reduce the amount of time that they have the flap—the subject of our revascularization research—we can improve patients’ lives.

No investigators had looked at the topic of recovery length systematically. Whereas traditionally the thought was that four to six weeks were necessary, this has been reduced to as short as two weeks. Our goal is eight to 10 days, while leaving the period at three weeks for major reconstruction cases. We know the difficulties that patients experience in getting back to their normal activities. They may feel OK and physiologically be fine, but psychosocially it’s hard for them to function in public. Our study brings us one step closer to reducing the impact of those issues.

We also explored the effect of patients’ chronological age on recovery time. Our results showed that the chronological age of the patient is not as important as the physiological age of the problem being corrected. These encouraging findings demonstrate that a wide range of patients potentially may benefit from the forehead flap procedure.

### Dramatically Improving Quality of Life and Cost-Effectiveness With Nasal Surgery vs. Steroid Sprays

This study originated when our division continually saw patients with severe physical nasal obstruction due to misplaced cartilage who were denied coverage for surgery by their insurers without first undergoing a minimum six-week steroid nasal spray regimen. As a result, patients had to make multiple visits to us for the nasal spray treatment, which we knew was ineffective. This compelled us to undertake a study of cost and quality of life comparing the two approaches. The study showed a dramatic improvement in quality-adjusted life years (QALY) with surgery. The results show that, over time, the incremental cost efficiency ratio (ICER) with septal reconstruction surgery is actually lower than the long-term costs associated with steroid nasal spray. These findings are designed to enable physicians to make better decisions for their patients. The findings also are designed to inform insurers that evidence exists proving that delaying surgery and putting patients on steroid sprays is neither as effective nor as cost-effective as possible.

Our hope is that these results will drive insurers to change their protocol.

## Investigating Immune Modulation Following Facial Nerve Crush Injury

There is significant interest in peripheral nerve recovery after injury: in the limbs, spinal cord, facial nerves, and other areas. Understanding the mechanisms that might improve recovery would benefit a wide variety of patients.

In theory, if we can understand how some aspect of the immune system may be positively or negatively affecting the regenerative process that occurs when a nerve is injured, then we can develop therapeutic agents that enhance the amount of recovery or reduce the amount of recovery time. An example is Bell's Palsy, where recovery may take

up to nine months; 75% to 80% of patients may have a "good" recovery, but their facial movement is irregular because nerve regrowth lags. The common treatment pathway is to administer steroids; however, that may not be selective enough for the immune system. There are some aspects of the immune system that we want to "turn on" and others that we want to "turn off."

The research also indicates (in an animal model) that steroids may not be beneficial in some instances in adult subjects, suggesting a potential age-dependent response to treatment that, in the future following clinical studies, may help guide therapeutic decisions. Human studies may follow.

## EDUCATION

### Fellowships Focused on Facial Plastics

Across the U.S., there are fewer than 50 certified facial plastics fellowships, each aligned with an individual practitioner. One is our division's own Sam P. Most, MD. In fact, Dr. Most is a fellowship director. This one-year program focuses exclusively on facial plastic and reconstructive surgery. The majority of applicants are

otolaryngologists; however, a number of plastic surgeons also apply each year.

As with our research activities, our fellowship program underscores our pledge to advance our specialty so that more patients may benefit from the most effective facial plastic and reconstructive surgery techniques.

## Success Stories

### Traveling the World to Help People With Facial Deformities

For the past three years, Sam P. Most, MD, has traveled to Phnom Penh to treat Cambodian children and adults who have congenital and acquired facial deformities: microtia, traumatic deformities, facial paralysis, and cleft lip palate. To date, the trips are annual but may increase to twice a year. For his next visit, Dr. Most will travel with two anesthesiologists, one resident, and one Fellow—all from Stanford—plus a group from the University of Washington, Seattle.

This outreach enables us to extend our expertise to patients who otherwise might never have access to our standard of care. These humanitarian efforts complement our

leadership in clinical excellence, coordinated care, research and discovery, and teaching and training.



*Dr. Most and Dr. Lee operating in Phnom Penh, Cambodia, 2015*



# Pediatric Otolaryngology



Personalized ENT Care for Children

At Lucile Packard Children’s Hospital (LPCH) Stanford and Stanford Children’s Health, the Pediatric Otolaryngology team delivers lifesaving and life-enhancing medical care for children with some of the most complex medical conditions in the world. Under the leadership of Chief Anna H. Messner, MD, the Pediatric Division remains a frontrunner in clinical excellence, while forging an institution-wide effort to advance basic science and clinical research in the pediatric arena.

## Pediatric Otolaryngology FACTS & FIGURES

Care team of



**8 doctors**



and **4 nurse  
practitioners**



Treat more than



**1,200  
PATIENTS**  
monthly

Ranging from the use of 3D printed constructs for microtia reconstruction to the development of novel, hair-cell-sparing aminoglycoside antibiotics in the laboratory, Pediatric Otolaryngology research endeavors at Stanford not only evaluate and treat children with the most comprehensive and precision-based medicine available, but they have become the definition of world-class care.

“Whether a child’s situation is routine or complicated, our team provides the highest level of care to meet the unique needs of a child. Our goal is to help children thrive. It’s what brings us the most joy, and it means we often reach out and collaborate with our colleagues in other medical disciplines from speech language pathology and cardiothoracic surgery to pulmonary medicine and gastroenterology, to name a few,” says Dr. Messner.

The Division’s collaborative mentality is evident throughout all inpatient and outpatient care practices at LPCH Stanford, and fosters an unparalleled educational environment for physicians and patients alike. It serves as a keystone for the development of more than eight multidisciplinary clinics within the Pediatric Otolaryngology Division alone, including Microtia and Ear Canal Atresia, Cleft and Craniofacial, Vascular Anomalies, Velopharyngeal Insufficiency (VPI), Vocal Cord Dysfunction (VCD), Pediatric Voice and Swallowing, Aerodigestive, and more. This represents the largest complement of Pediatric Otolaryngology multidisciplinary clinics in California.





In the Microtia and Atresia Clinic, directed by Kay Chang, MD, and Mai Thy Truong, MD, audiologists and otolaryngologists with extensive experience in the treatment of congenital ear anomalies work together across disciplines to provide a unique treatment plan for each child.

In the Velopharyngeal Insufficiency (VPI) and Vocal Cord Dysfunction (VCD) clinics, both directed by Dr. Messner, pediatric otolaryngologists collaborate with speech language pathologists who have specialized experience with these disorders.

The VPI clinic focuses on evaluating and treating patients with and without cleft palate who suffer from disorders of the velopharyngeal valve, affecting intraoral pressure to produce speech sounds.

In the VCD clinic, patients are evaluated for laryngospasm or paradoxical vocal cord motion during exercise. Because LPCH Stanford is located in Silicon Valley, there are a high number of competitive and ambitious teenagers who experience VCD, often during athletic events. In this clinic, patients undergo laryngoscopy with exercise to establish a diagnosis. Not only does this allow for the diagnosis of this often elusive problem, but also patients are able to practice maneuvers that can reduce the incidence of spasm with exercise during the same visit.

For patients with complex voice and swallowing disorders, the Pediatric Voice and Swallowing Clinic, directed by Douglas Sidell, MD, and April Johnson, MA, CCC-SLP, is one of the most advanced multidisciplinary clinics in California. Solely dedicated to the comprehensive evaluation of pediatric voice and swallow function, otolaryngologists and speech pathologists in this clinic use modern techniques and state-of-the-art software to analyze the pediatric voice, obtaining both acoustic and aerodynamic data



for diagnostic and treatment purposes. In concert with pediatric otolaryngologists, who perform laryngeal stroboscopy and endoscopic swallow evaluations, this objective data enhances the ability for each patient to obtain an accurate diagnosis, to monitor progress surrounding surgical and non-surgical therapy, and to better establish future treatment goals that are highly individualized.

Whether in the inpatient arena or outpatient clinics, the collaborative efforts put forth by the Division of Pediatric Otolaryngology allow each patient to receive high-end medical and surgical care from the best physicians in the world. Tailored to each child's needs and backed by Stanford's research reputation, the care provided by Lucile Packard Stanford Pediatric Otolaryngology is the heart of Precision Medicine.

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*“Everything we do affects a child's senses. If we have a child with middle ear disease, we help them hear. If we have a child with chronic sinus disease, we help them breathe and smell. Or a child who can't breathe without a trach, we help them breathe alone.”—Mai Thy Truong, MD*

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## Caring for Three Needs: Microtia, Atresia, and Hearing

The Microtia and Ear Canal Atresia team at Lucile Packard Children’s Hospital Stanford is internationally recognized for their treatment, education, and research of microtia.

The Pediatric Otolaryngology Division consists of a team of physicians, specialists, and surgeons working together to care for the unique needs of children, including diagnosis, treatment, and education for microtia and the cosmetic and hearing needs of the child.

Kay Chang, MD, and Mai Thy Truong, MD, oversee a dedicated microtia clinic, and together they are surgically creating ear reconstructions from a 3D model of each child’s own ear. They also work closely with pediatric audiologists and speech specialists to address any hearing and speech issues or concerns.

Microtia—a congenital deformity of the outer ear where the ear does not fully develop during the first trimester of pregnancy—occurs in over 1 in 5,000 births and can vary depending on ethnic background. In 90% of cases, it affects only one ear, usually the right ear, and is more common in males. Microtia is often associated with absence of the ear canal (called canal atresia or aural atresia) or an extremely narrow ear canal (canal stenosis).

### Rib Cartilage Graft Surgical Reconstruction

Dr. Chang and Dr. Truong work together to perform the two-stage Firmin technique with a rib cartilage graft. In fact, they are among the only American surgeons to have been personally trained in this technique by its creator—Dr. Francoise Firmin of Paris, France, one of the world’s all-time leading experts in the field.

Rib cartilage reconstruction of microtia has been around since the 1920s and has evolved since then to more advanced techniques of Dr. Burt Brent in the 1980s. Dr. Satoru Nagata and Dr. Firmin, improving the artistry and reliability of the technique over the last 30 years, have further refined this.

As part of the reconstruction, and thanks to advances in 3D technology, Drs. Chang and Truong create a 3D printed

model of the mirror image of the opposite ear—enabling the construction of the most symmetric ear possible.

The first stage involves harvesting rib cartilage from the chest, and then carefully sculpting the harvested rib cartilage into a framework that is shaped like an ear. This framework is implanted in a skin pocket underneath the scalp on the skull where the new ear will be located. In the second stage, performed three to four months later, incisions are made behind the ear to release the ear from the scalp skin, and the cartilage framework is lifted up to give it adequate projection. A skin graft is used to help cover the backside of the newly lifted ear. Sometimes, additional minor stages are performed to improve the shape of the ear or the appearance of scars, or to elevate the ear even further.

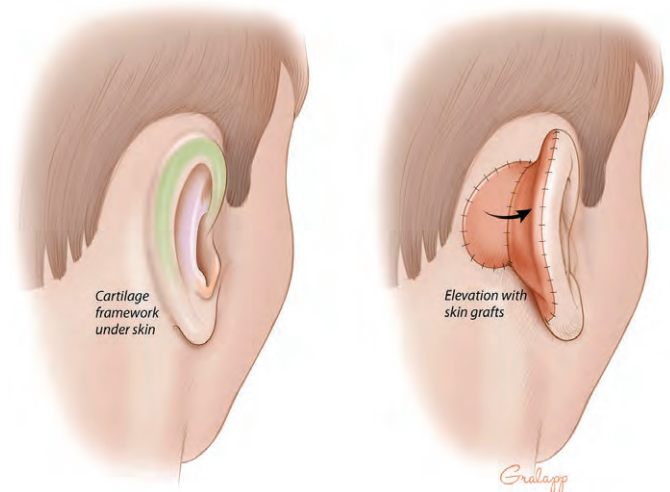


Illustration: Christine Galapp

Canal atresia repair of the ear canal is done after the completion of the two-stage microtia repair for patients who are candidates. There are also modern implantable hearing options that can be coordinated to be performed simultaneously with the second stage of microtia repair in those patients who have unfavorable anatomy for canal atresia reconstruction.

Dr. Chang and Dr. Truong address the microtia, canal atresia, and hearing needs of the child in a comprehensive fashion, optimizing *both* form and function.



## Complex Aerodigestive Disorders— A Team Approach, Tailored to a Child’s Needs

The Aerodigestive Program at Lucile Packard Children’s Hospital Stanford consists of a multidisciplinary team of specialists and services (otolaryngology, pulmonary medicine, gastroenterology, nutrition, pediatric surgery, speech-language pathology, genetics, and social work) dedicated to caring for kids who have complex upper airway disorders and/or upper gastrointestinal tract disorders. Patients are referred from local, regional, and international providers for the coordinated diagnosis and treatment of laryngeal and tracheal disorders, esophageal and swallowing disorders, and pulmonary disorders.

The Aerodigestive team, directed by Pediatric Otolaryngologist Douglas Sidell, MD, in concert with the division of Pediatric Pulmonary Medicine, coordinates clinic visits, diagnostic procedures, and operating room visits among all necessary health care providers for children. This coordinated effort not only provides children with the highest quality of care, but also maximizes patient safety, minimizes discomfort, and reduces costs to the patient.

This program reduces the burden when juggling the multitude of clinic visits, diagnostic studies, and procedures that are often required in the management of complex airway and esophageal disease. The Aerodigestive program strives to eliminate any confusion or burden—families are contacted by a caring and personable scheduler, interviewed by a specialized nurse practitioner, given a clinic appointment where all providers see the patient during the same visit, and then given a comprehensive, organized plan for moving forward. Many patients will undergo a combined diagnostic endoscopic procedure the following day. This enhances communication between practitioners, ensures that the patient is receiving a clear and concise message about the diagnosis, and minimizes the need for repeat anesthetics or procedures. Other benefits include reducing time off from work and school by going to fewer clinic visits and procedures. Our approach also reduces the overall procedural costs, and increases the precision, efficiency, and quality of care that the child receives.

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*“Taking care of children is an honor unlike anything else in the world.”—Douglas Sidell, MD*

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## Global Pediatric Programs

The Pediatric Otolaryngology Division reaches beyond its borders at Stanford to continually enhance the educational relationship with medical students, surgical residents, and visiting scholars from other countries. In fact, the Division has a unique teaching relationship with several medical centers abroad where our faculty dedicates time through medical missions. Drs. Messner and Koltai have helped develop a relationship with the University of Zimbabwe, and Dr. Sidell is working to help develop a pediatric otolaryngology program in Nepal. Dr. Chang has multiple collaborations with the top pediatric otolaryngologists in China and is frequently invited there to give lectureships and courses.



## Success Stories

### Multilevel Airway Reconstruction

A 6-month-old baby with a history of congenital cardiac anomalies and near-complete atresia of the larynx and upper trachea presented for airway reconstruction. He had undergone tracheostomy shortly after birth but had no ability to speak or make any sounds due to the location and severity of his airway obstruction. He was dependent on a gastric tube for nutrition.

The boy underwent a comprehensive multidisciplinary evaluation involving otolaryngology, complex care, and speech-language pathology. In the voice and swallow clinic, a dynamic examination of the larynx and fiberoptic



endoscopic swallow evaluation were performed. He then underwent a two-stage airway reconstruction at Lucile Packard Children's Hospital Stanford. In the operating room, members of the airway team were able to open the trachea below the level of vocal cords using a three-part scaffold that was created using rib cartilage. This combined technique allowed for support of the lateral airway while expanding the trachea's anterior surface. After dividing and suspending the fused vocal cords, the anterior commissure of glottis was reconstructed and a stent was placed in the airway.

Following surgery, the child's care included close monitoring and aggressive treatment of airway and esophageal inflammation, as well as management of his voice and swallow function. Through the combined efforts of the child's parents and members of the Aerodigestive team and Complex Care clinic, his tracheostomy tube and gastric tubes have been removed, he has a speaking voice, and he continues to grow and thrive. During his second birthday, he happily blew out the candles on his cake.

## Grading System for Ototoxicity—an International Standard

The platinum chemotherapy agents cisplatin and carboplatin are widely used in the treatment of adult and pediatric cancers. In at least 60% of pediatric patients, cisplatin causes significant hearing loss. Reducing cisplatin and high-dose carboplatin ototoxicity without reducing efficacy is important (“Platinum Induced Ototoxicity in Children,” *Journal of Clinical Oncology*, 2012 by Dr. Kay Chang and colleagues). In the Stanford Pediatric Otolaryngology Division, Dr. Chang is actively involved in several human clinical trials looking at the prevention of cisplatin ototoxicity that may drastically decrease the number of children developing hearing loss after chemotherapy, and is internationally known for the Chang Ototoxicity Scale, presented in the *Journal of Clinical Oncology*. As the co-chair of the Ototoxicity Working Group for the 2010 International Society of Pediatric Oncology (SIOP) Meeting, Dr. Chang later created the SIOP Ototoxicity Grade, which has become the de facto international standard used for all Children’s Oncology Group (COG) and SIOP multi-institutional chemotherapy protocols.

These standardized assessments are aimed at improving methodologies for accurately assessing and characterizing ototoxic effects in children. This is particularly important since children are significantly more susceptible to ototoxicity than adults. Furthermore, while the effects of ototoxicity may be quite limited in adults who have mastered speech

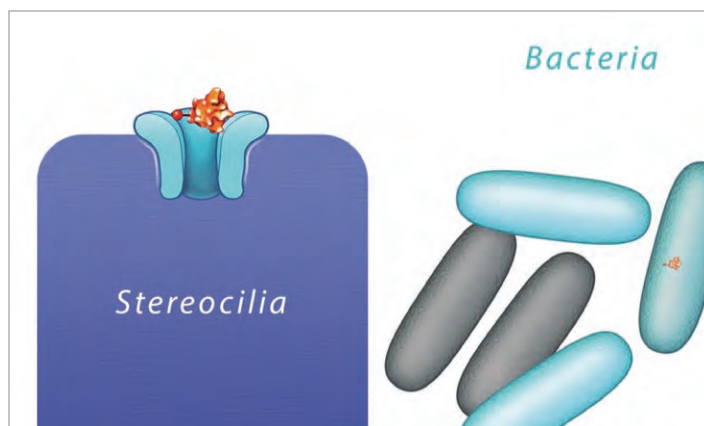
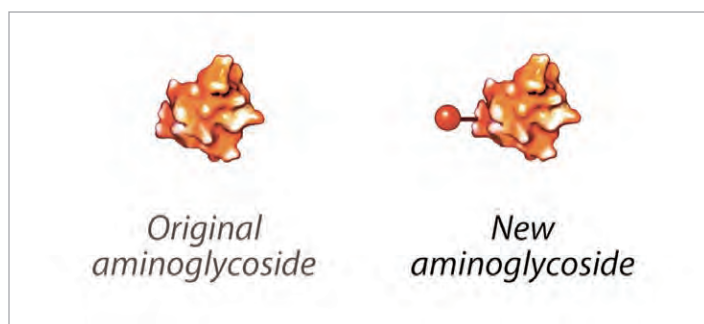
and language, in pre-lingual young children, ototoxicity may result in severe speech delay and the inability to ever assume a normal role in society. While the children may be cured of their cancer, they never fully recover from their treatment and may suffer a lifelong inability to communicate with others.

While accurately monitoring cisplatin ototoxicity may provide some insights into improved dosing strategies for reducing adverse effects in children, a more exciting approach is actual prevention of ototoxicity by administering various otoprotective agents. Dr. Chang is heading a multi-institutional clinical trial evaluating the extended-release steroid formulation OTO-104 as a transtympanic injection to prevent hearing loss in children receiving cisplatin therapy. He has multiple collaborations with pediatric oncologists employing standardized protocols utilizing his grading scales to investigate these as well as other otoprotective agents, and a collaboration including the Stanford Pharmacology Department, LPCH Pediatric Audiology Department, and Canadian Pharmacogenomic Network for Drug Safety to isolate the genes responsible for increased susceptibility to cisplatin ototoxicity. Hopefully by better understanding these basic genetic and molecular mechanisms of ototoxicity, we will be able to eliminate this most devastating late effect of chemotherapy in young children.



## An Antibiotic That Eliminates Risk of Hearing Loss? From Basic Science to Clinical Applications

Aminoglycosides are the most commonly used class of antibiotics worldwide, and often considered a lifesaving necessity. For 20 years, and despite newer, alternative antibiotics, aminoglycosides have remained the mainstay treatment worldwide for many bacterial diseases, including pneumonia, peritonitis, and sepsis. They also are often used when other antibiotics have failed to treat infections of unknown origins. The problem? An estimated 20% to 60% of all patients who receive these antibiotics suffer partial or complete hearing loss.



Illustrations: Christine Gralapp

In a study published in the January 2015 issue of *The Journal of Clinical Investigation*, Stanford researchers report that they have developed a modified version of an aminoglycoside that works effectively in mice without the risk of causing deafness or kidney damage, another common side effect.

The two senior authors—Anthony Ricci, PhD, Professor of Otolaryngology – Head & Neck Surgery and Alan Cheng, MD, Associate Professor of Otolaryngology – Head & Neck Surgery—joined forces in 2007 to explore the idea of creating new and improved versions of aminoglycosides based on a simple yet groundbreaking idea born of Dr. Ricci’s basic

science research into the biophysics of how hearing works within the inner ear. Dr. Ricci says it’s a great example of how basic science research is directly translatable into clinical applications.

Four years of research later, the Stanford scientists had produced 5 grams of the newly patented antibiotic, N1MS, which is derived from sisomicin, a type of aminoglycoside.

N1MS cured urinary tract infection in mice just as well as the parent antibiotic but did not cause deafness, study results show. The study presents a promising new approach to generating a new class of novel, nontoxic antibiotics. Dr. Ricci is an expert on the process by which sound waves open ion channels within the sensory hair cells of the inner ear, allowing their conversion to electrical signals that eventually reach the brain.

Because aminoglycosides cause deafness by killing these hair cells, which cannot be regenerated, Dr. Ricci postulated, why not simply make the drug molecules unable to enter the cells’ channels? This idea made sense to Dr. Cheng.

“As a clinician-scientist, I treat kids with hearing loss,” says Dr. Cheng. “When a drug causes hearing loss it is devastating, and it’s especially disturbing when this happens to a young child as they rely on hearing to acquire speech.”

The Cheng Laboratory in collaboration with Dr. Ricci’s group is building on previous studies from both laboratories that discovered how these drugs enter hair cells to exert toxicity. A five-year grant from the National Institutes of Health will help them advance this work that could ultimately benefit millions of patients worldwide and eliminate aminoglycoside antibiotic ototoxicity as cause for hearing loss.

Dr. Cheng and Dr. Ricci are also working with SPARK, a program at Stanford that assists scientists in moving their discoveries from bench to bedside—particularly important as they enter the new landscape of drug development.

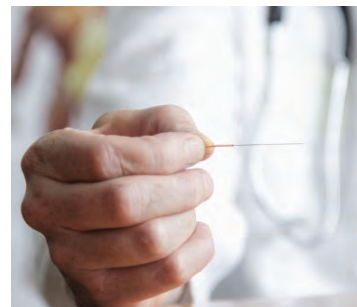
## Acupuncture Reduces Pain in Children After Tonsillectomy

What if we could produce a “painless tonsillectomy” for children? Surgeons have searched for the technique or medication that would do this for years. Two departments at Stanford School of Medicine have published research providing evidence that acupuncture reduces pain and enables early return of diet after operations. The research was conducted by doctors in the Department of Otolaryngology – Head & Neck Surgery and the Department of Anesthesia, and published in *The Laryngoscope*.

The study evaluated the effect of intraoperative acupuncture on post-tonsillectomy pain in the pediatric population.

While the study of acupuncture during surgery is a relatively new area of research, one of the strengths of this study is its rigorous double-blinded randomized design with a sham acupuncture control.

Acupuncture is beginning to gain traction in Western medicine, with high-profile research studies being conducted by prestigious universities such as Stanford University.



## Success Stories

### Complex Airway Reconstruction Improves Voice and Swallow Function: A Multidisciplinary Approach

A 4-year-old child from Northern California had a history of previous airway reconstruction with inflammation in airways and risk of aspiration. He had persistent laryngotracheal stenosis with over 95% obstruction of the airway. When he first presented to the Aerodigestive Clinic, he underwent an airway and swallow evaluation in the clinic, as well as a diagnostic “triple-endoscopy” under a single anesthetic in the operating room. Following his evaluation, a comprehensive and personalized treatment plan was created for his upcoming airway surgery. With the aim of improving the chances of a successful reoperation, the plan included treatment to reduce inflammation of the airway and digestive tract, and the prevention of infection. During revision airway reconstruction, the aerodigestive team identified thick scar tissue extending from the vocal cords to the tracheostomy tube. The operation focused on resecting scar tissue from the trachea, enlarging the airway, and separating and reimplanting the vocal cords. After reconstructing the trachea and the vocal cords, a stent was placed.

After surgery, our plan of care for the child encompassed airway monitoring, aggressive treatment of airway and

esophageal inflammation, and management of voice and swallow function. Thanks to collaboration between the child’s parents and our aerodigestive team, the update is positive: We have removed his tracheostomy tube. He is growing, thriving, and speaking.





# Comprehensive Otolaryngology

Newly Formed Division Offers Comprehensive ENT Care and Collaboration With Subspecialties



Through the Stanford Comprehensive ENT Clinic (also known as the Adult General ENT Clinic), Dr. Jennifer Y. Lee, Clinic Chief of Adult Otolaryngology, along with Dr. Uche Megwalu and their care team, is providing compassionate, high-quality medical care. A primary goal of our comprehensive ENT practitioners is to provide expedited access for patients with acute illness who need to be seen as soon as possible. With broad training and clinical interests, these practitioners are ideally suited to evaluate and provide coordinated care for patients with multiple ENT problems.

Our comprehensive ENT clinic was created due to an unmet need—while Stanford has world-class specialists that cover specific aspects of ENT, we knew that overall care would be enhanced by comprehensive specialists facility with the broad spectrum of diseases in our field. The comprehensive OHNS division works in conjunction and collaborates with the seven subspecialties within Otolaryngology – Head & Neck Surgery to facilitate care for their patients and address their concerns.

In collaboration with Dr. Jackler, Dr. Lee designed a clinical program that would work with Stanford’s rapidly growing primary care program as well as our expanding network of care. Dr. Megwalu, an experienced and highly trained comprehensive otolaryngologist who joined Stanford in 2016, also has broad-ranging interests.

While our comprehensive otolaryngologists often receive direct referrals, many patients seeking Stanford ENT care that don’t name a specific doctor are directed to the Stanford Comprehensive ENT Clinic.

“Our ultimate goal is to provide comprehensive, excellent care that competes with other world-renowned medical centers. There is not a day that goes by



## Comprehensive Otolaryngology **FACTS & FIGURES**

Newest division within  
Otolaryngology formed in

# 2013

One of few clinics in the country focusing on **eustachian tube dysfunction** and treatments including eustachian tube balloon tuboplasty performed by Dr. Lee

**UP TO 400**  
patients treated monthly



Areas of research focus include the use of large datasets, like the Surveillance, Epidemiology, and End Results (SEER) program with the National Cancer Institute

that I don't talk to a subspecialist at Stanford or a primary care doctor—we create that bridge in care,” explains Dr. Lee. “We take care of their medical or surgical needs.” Dr. Lee’s clinical interests include chronic sinusitis, eustachian tube dysfunction, salivary gland tumors, and endocrine tumors.

This division handles everything from ear pain to sinusitis, sore throat, and laryngitis. As broadly trained surgeons, comprehensive otolaryngologists also often provide surgical care for a variety of conditions such as nasal

polyps to neck masses, thyroid nodules, salivary gland masses, and mouth lesions.

To better serve our community, further comprehensive ENT practices are currently open in SHC, including Diablo ENT and the East Bay. In the coming years, our comprehensive ENT clinic is expected to grow considerably by adding both new physicians and practice sites such as in Emeryville and Pleasanton.

LEADING EDGE + COORDINATED CARE

## Innovations in Eustachian Tube Dilation

### Clearing the Air in the Ear

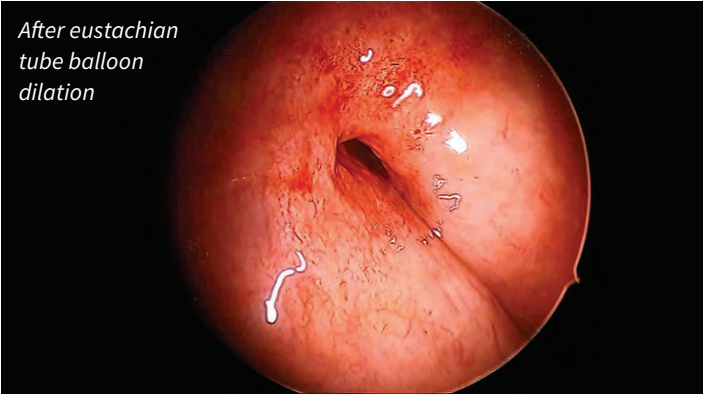
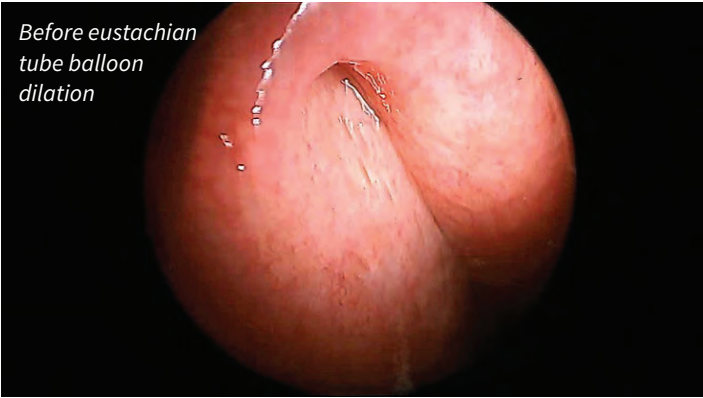
Excruciating ear pain can be caused by eustachian tube dysfunction (ETD), in which the tunnel that connects the middle ear to the back of the nose doesn't open properly. In addition to pain during altitude changes, sufferers complain of an unpleasant “clogged” sensation, muffled hearing or fullness. And while eustachian tube dysfunction is considered a common condition, it does not have many solutions. Traditionally, placing an ear tube in the ear drum may alleviate the symptoms temporarily. Balloon dilation—which dilates this tunnel to allow return of function to the eustachian tube—is a novel surgical technique used to treat ETD.

Dr. Lee is one of the few in the country to focus on eustachian tube dysfunction and treatments—and in particular the eustachian tube balloon tuboplasty. While balloon tuboplasty is not 100% effective, tympanostomy tube placement is not 100% effective either. Publications report about a 75% efficacy that seems to last for about five years or potentially longer. It is also not at this time FDA approved, but randomized clinical trials for efficacy are currently underway and approval is anticipated within the next couple of years.

The procedure involves inserting a small camera in the patient’s nose and threading a flexible balloon into the opening of the eustachian tube in the nasopharynx. The balloon is dilated leading to stretching of the eustachian tube.

This dilation decreases and squeezes out inflammatory cells such as leukocytes and proteins from the surface and under the surface to allow the tunnel to reopen and return function of the eustachian tube.

Dr. Lee is developing an algorithm for new patient referrals for eustachian tube dysfunction. She has had success rates of around 80% in her current practice. She is currently studying treatment of post-radiation, eustachian tube dysfunctions with serous otitis media.



## Training the Next Generation: From Flipped Classrooms to Simulation

Flipped classrooms reverse the traditional learning environment by delivering classroom instruction—via online lectures and online collaboration—outside of the classroom. It’s an approach increasingly used in the medical field along with simulation to augment the curriculum. As an example, in addition to flipping the classroom, the Comprehensive Otolaryngology Division is leveraging high-fidelity, complex, scenario-based simulation to improve patient care. Experienced in designing surgical simulation training, Dr. Lee leads all OHNS residents through multiple complex scenarios to teach not only task trainers but also the method of communication during high-stress situations.

The biannual simulation curriculum for Otolaryngology residents contains some of the most complex scenarios that take place at the Immersive Training center at the

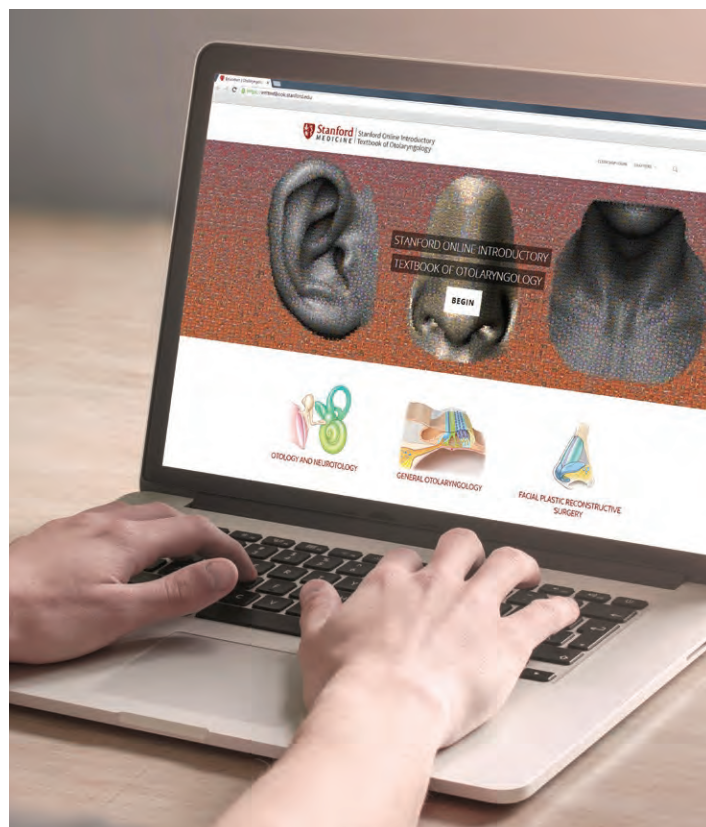
Li Ka Shing Center, part of Stanford School of Medicine and its affiliated hospitals. Stanford is a pioneer of techniques, technologies, and applications at the Center for Immersive and Simulation-based Learning (CISL). Stanford created CISL to further integrate simulation into training, and to achieve the maximum scholarly benefit offered by individual laboratories and investigators.

Under the direction of Dr. Lee, the division’s scenarios combine the clinical and communication skills necessary for handling Otolaryngology emergencies. As an example, the team developed an innovative way to simulate a massive arterial bleed, and another scenario focused on an intra-operative airway fire. Both scenarios promote high engagement of learners during very stressful clinical situations.

## A Khan Academy–Style Online Book for OHNS

What Khan Academy has done to provide free, world-class education for anyone, anywhere in field after field, OHNS hopes to do for Otolaryngology. Titled SOITO for “Stanford Online Interactive Textbook of Otolaryngology,” the multi-authored introductory textbook was created entirely by faculty and trainees.

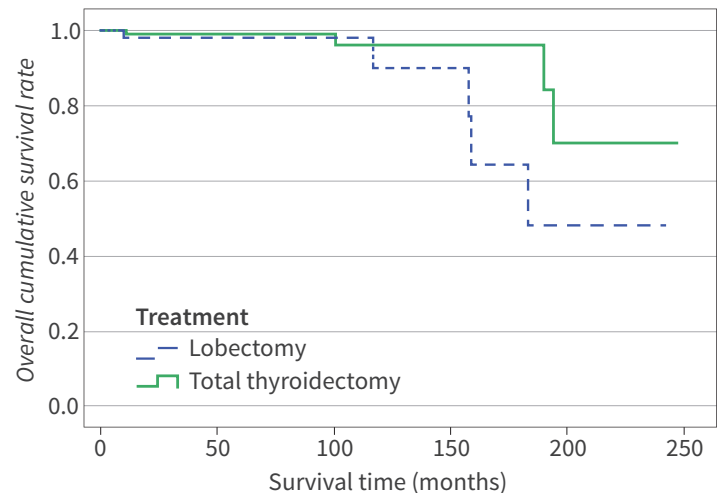
In development for several years, and under the editorial leadership of Dr. Lee, this online book is targeted primarily for medical students, beginning residents, and patients interested in a reliable source of sophisticated medical information. With well-illustrated online text, continuously updated, the concept is to make the information freely available to trainees and patients worldwide. The book includes several hundred original illustrations by Christine Galapp, a CMI-board certified medical illustrator. As a funded pilot project, this material will be augmented with a series of 10-minute topical videos for OHNS.



## Head and Neck Cancer Epidemiology and Comparative Effectiveness

Head and neck cancer is the seventh most common cancer in the world, accounting for approximately 10% of cancers, with an estimated 130,000 new cases in the United States in 2015. Head and neck cancer is an important cause of cancer mortality, with an average 5-year cumulative survival of 65% in the United States. In addition to tumor-specific factors, non-clinical factors, such as race, gender, and socioeconomic status, are known to significantly influence patient outcomes.

Within the Comprehensive Otolaryngology Division, areas of research focus include the use of large datasets, like the Surveillance, Epidemiology, and End Results (SEER) program with the National Cancer Institute, to evaluate the impact of sociodemographic and clinical factors on treatment choice and survival outcomes, and to evaluate the comparative effectiveness of treatment options in the management of head and neck cancer. A recent study by Dr. Megwalu and colleagues published in *American Journal of Otolaryngology* revealed that for patients with advanced laryngeal cancer, younger age and residing in a county with low median household income increased the odds of receiving surgical therapy, after adjusting for stage, laryngeal subsite, race, sex, marital status, and year of diagnosis. Furthermore, African-American patients



and older patients had an increased risk of death from laryngeal cancer. Conversely, female patients and married patients had a lower risk of cancer-specific death.

Another study, published in *Anticancer Research*, evaluated survival outcomes in patients with early-stage laryngeal cancer. The study found that the use of radiotherapy for early-stage laryngeal cancer has increased over time. Patients who were treated with definitive radiotherapy had a 30% increased risk of mortality compared with patients who were treated with surgical resection.

## Success Stories

### “No One Wanted to Take Care of This Man”

Two and a half years ago, a patient in his late 20s with tuberous sclerosis ended up at the Stanford Comprehensive ENT Clinic after no other local otolaryngologists would touch his case. He suffered from a rare multisystem genetic disease that causes benign tumors to grow in the brain and other vital organs. He also had generalized daily seizures, plus a swollen face and tumor that concerned his parents. While other ENTs told him he had a salivary infection, he ended up diagnosed

with a tumor in his salivary gland. After a biopsy and workup, Dr. Lee discovered two tumors—one in his parotid gland and one in his thyroid gland. They were different kinds of cancer. Dr. Lee removed them both surgically, and since then, the patient has been without symptoms. He continues to come to Stanford every year for monitoring, and his family has become part of the Stanford family as he switched all his medical care to Stanford after their positive experience with us.

## Health Literacy Pilot Study—First of Its Kind for Otolaryngology

Can individuals obtain, process, and really understand basic health information and services to make appropriate decisions regarding their health? The degree to which they can do this is called health literacy, and it's the subject of a pilot study at Stanford, and the first of its kind in Otolaryngology. Due to its widespread impact on health and well-being, health literacy has quickly caught the attention of researchers, policy makers, and clinicians.

Health literacy goes beyond the ability to read and write (fundamental literacy), and also includes other skills such as speaking, listening, and having adequate background medical knowledge and the ability for self-advocacy. It is estimated that 90 million adults in the United States have inadequate health literacy. Health literacy has been shown to impact outcomes in a number of medical conditions, including asthma, COPD, diabetes, and hypertension.

Unfortunately, health literacy has been grossly understudied in the otolaryngology literature. At Stanford, the research team in the Comprehensive Otolaryngology Division is examining the impact of health literacy on head and neck surgery patient outcomes. Ongoing work includes identifying appropriate and practical measures of health literacy in clinical practice; assessing the determinants of health literacy; and evaluating the impact of health literacy on specific outcomes such as treatment compliance and quality of life.



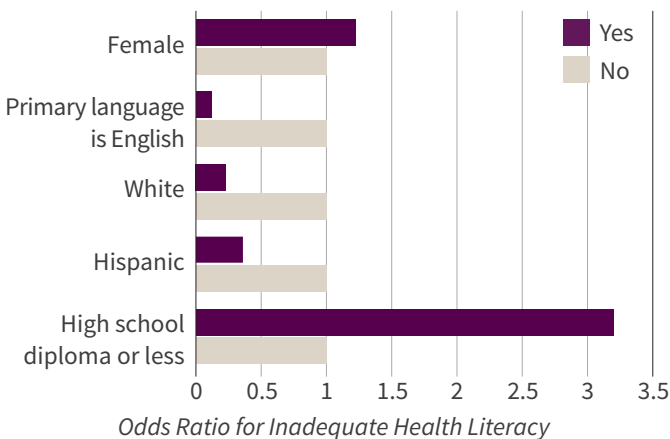
*African-Americans and elderly individuals had increased risk of cancer-specific death\**



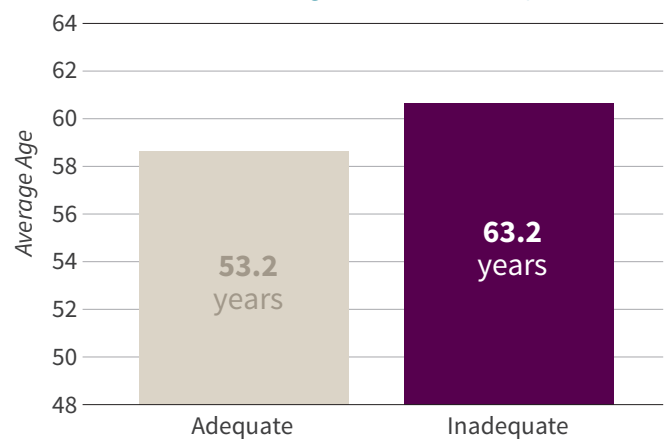
\* After adjusting for stage, laryngeal subsite, sex, marital status, and year of diagnosis

So far, the pilot study has included information from more than 300 patients, and found that 14% of patients had difficulty filling out medical forms, 19% had difficulty reading medical material, and 16% had difficulty understanding written information about their medical condition. Overall, 10% of patients had inadequate health literacy. This is remarkable given that Silicon Valley has a reputation for having a high proportion of highly educated individuals. Patients for whom English was not a primary language, racial minorities, and patients with only a high school education or lower were more likely to have inadequate health literacy. Age and gender did not affect health literacy. The next step is to assess the impact of health literacy on patient outcomes, and to design specific interventions to address health literacy and health outcomes in our patient population.

Variables Impacting Health Literacy



Impact of Age on Health Literacy





# Sleep Surgery

The Sleep Surgery Division within Otolaryngology – Head & Neck Surgery is a central component of the world-renowned Stanford Sleep Center. A substantial proportion of patients with sleep disturbances experience anatomical obstruction of their upper airways during sleep. Aside from the discomfort of lacking a good night's sleep, this can lead to serious health problems affecting the heart, blood vessels, and brain. In selected patients, surgical improvement of the airway may ease, and sometimes cure, sleep difficulties. Stanford sleep surgeons offer the full spectrum of modern procedures and devices, many of which were invented at Stanford.

Stanford's Sleep Surgery Division Chief, Robson Capasso, MD, FAASM, is dually trained in sleep medicine and surgery, enabling expert interpretation of sleep studies and refined judgment regarding whether surgery is an option and, if so, which procedure is best suited for each patient. Co-director of the sleep surgery fellowship Stanley Liu, MD, DDS, is dually trained in sleep surgery and maxillofacial surgery. He has further advanced Stanford's pioneering facial skeletal reconstruction procedures to stabilize airway collapse during sleep. We also are proud to have Robert Riley, MD, DDS, a founder of the sleep surgery field, as a member of our faculty.

### Offering Every Surgical Intervention to Treat Obstructive Sleep Apnea

The anatomy, physiology, and goals of obstructive sleep apnea (OSA) treatment vary from patient to patient. In the era of Precision Health, it is important that patients receive the most advanced interventions for individualized care.

The most commonly used medical management, continuous positive airway pressure (CPAP), is tolerated only by approximately half of all diagnosed patients. While evidence suggests that palatal surgery, the most commonly performed surgical procedure for OSA, produces long-term improvement in clinically relevant outcomes, a significant proportion of patients requires additional procedures. Most centers don't go beyond CPAP and palatopharyngoplasty, and the few that do usually specialize in limited additional techniques.

The exception: Stanford. Our Sleep Surgery Division is the world's founding center of comprehensive sleep medicine and surgery. The pioneering work here by Christian Guilleminault, MD, Robert Riley, MD, DDS, and Nelson Powell,

MD, DDS, established the original Stanford Sleep Surgery protocol.

Inheriting this remarkable legacy are Drs. Capasso and Liu, who collaborate closely to meet the needs of OSA patients and to continue to refine and expand the original Stanford Sleep Surgery protocol for individualized care.

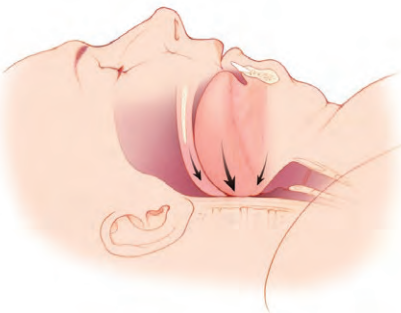


Illustration: Christine Gralapp

## Sleep Surgery FACTS & FIGURES

Stanford Sleep Surgery has corrected sleep disorders for

**35+ yrs**

Since 2010, over **50**

**international physicians** from **20 countries** have visited to observe the Sleep Surgery Division clinic

**100%**

physicians received placements in U.S. academic positions after Stanford's one-year clinical instructorship in Sleep Surgery



"Smartphone apps for snoring" study honored as article of the year

**126 smartphone apps screened** with only **13 meeting criteria** for inclusion in our study



*More than 1,500 individual snores were compared*

Approximately **50% of all patients** unable to tolerate CPAP therapy

**OVER 80%** of our patients with successful outcome after MMA, TORS, or upper airway stimulation surgery

## Leading Edge Surgical Solutions to Overcome Sleep-Disordered Breathing

For each patient, we select the appropriate surgical intervention after carefully evaluating each individual's clinical presentation, maxillofacial structure, and upper airway collapsibility with the patient awake and asleep.

We continue to specialize in facial skeletal reconstruction for stabilization of the upper airway (maxillomandibular advancement—MMA). MMA was pioneered at Stanford, and we have brought it into the contemporary era with intraoral scanning, 3D printing, and virtual surgical planning. Sophisticated preoperative planning allows us to stabilize the upper airway while preserving and enhancing facial and dental-occlusal harmony.

A new procedure is the implantation of a minimally invasive device that delivers nerve stimulation to upper airway muscles. This system has been validated in a large clinical trial that shows significantly improved airway stability in select OSA patients.



We utilize robotic assistance to improve visualization and maneuverability for transoral approach to the tongue base, commonly identified as a site of obstruction.

## Delivering an Integrated, Multidisciplinary Continuum of Sleep Testing and Treatment



Attentive sleep evaluation and testing are keys in properly designing individualized treatment plans. The Sleep Surgery Division collaborates closely with the renowned Stanford Sleep Sciences and Medicine Center, offering integrated care incorporating a continuum of sleep testing, medical and surgical diagnosis, and treatment.

OSA quite rarely presents in isolation; most patients suffer from other sleep issues such as insomnia. In those cases, at the Sleep Sciences and Medicine Center, each patient meets with a behavioral therapist, complementing the comprehensive management of sleep disorders.





# Success Stories

## “It has profoundly changed my life for the better.”

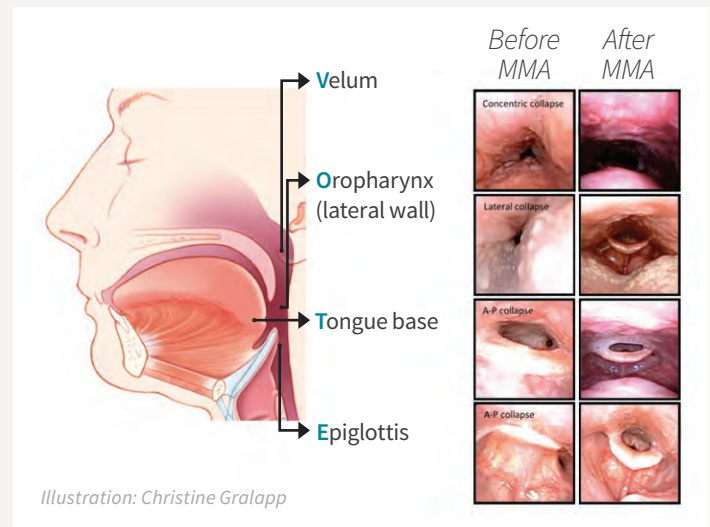
Paul’s sleep apnea wasn’t diagnosed until he presented to Stanford Sleep Surgery in his 50s. By then, he had suffered with the condition for more than 30 years without effective treatment.

In his teens, his deviated septum was repaired. It was repaired again 20 years later. At that time, he also underwent palate surgery. But still, he continued to suffer from sleep apnea.

In 2013, his wife urged him to have another sleep study, as his snoring and thrashing at night were keeping her awake. Following the study, Paul received a CPAP machine. But like many patients, he would invariably remove it during the night. His symptoms worsened. He needed to take naps in the morning, at lunch, and before leaving for work.

At last, Paul visited Stanford Sleep Surgery. Our sleep study showed that, on average, he stopped breathing 82 times per hour. Dr. Liu scheduled him for MMA surgery.

Now, Paul says, “the change in my sleep is nothing short of a miracle. I no longer have dark circles under my eyes, I am breathing through both nostrils, and I am getting a full night’s sleep. I wake up refreshed, and I do not experience any kind of tiredness or feelings of physical exhaustion at any point in the day. It has profoundly changed my life for the better.”



## RESEARCH

### From Surgery to Smartphones: Elucidating Evidence for Diverse Sleep Management Techniques

Stanford Sleep Surgery is committed to advancing the understanding of OSA surgery selection and treatment outcomes. To fulfill that commitment, we engage in vital research, collect substantial data, and publish extensively.

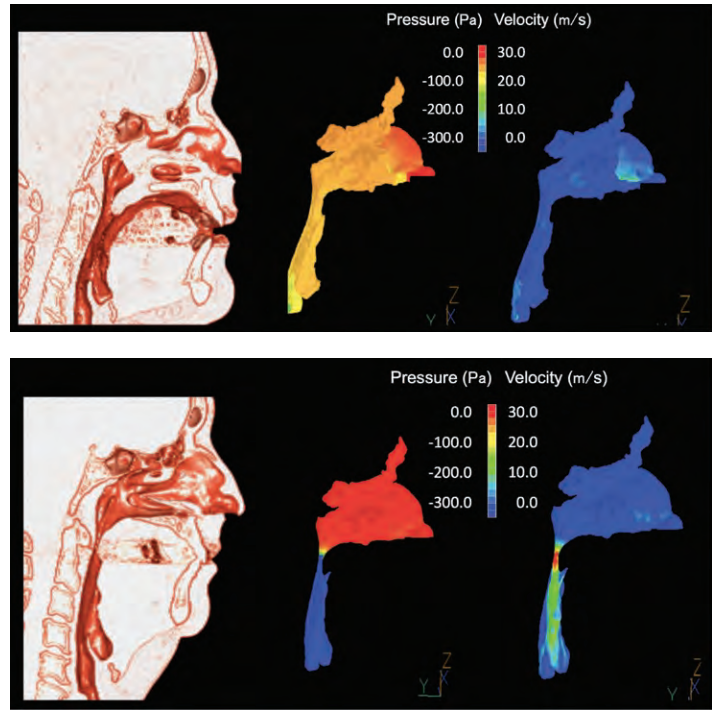
The available literature on outcomes for surgical OSA management is quite confusing. In close collaboration with international visiting scholars and instructors, we have engaged in a series of systematic reviews and meta-analyses assessing the quality of evidence in OSA surgery. This body of work has helped guide discussions on sleep study data and clinically relevant outcomes.

As part of our leadership in the use of novel diagnostic instruments, we have produced much-needed data about drug-induced sleep endoscopy and its use in understanding dynamic airway collapse.

We demonstrated that patients with lateral pharyngeal wall collapse have more severe oxygen desaturation during sleep. We showed that MMA surgery stabilizes lateral pharyngeal wall collapse predictably. In another study, we showed that stabilizing the lateral pharyngeal wall is related to decreased airflow velocity behind the soft palate and improvement in oxygen saturation after MMA surgery.

Noteworthy research also includes our assessment of digital health tools in snoring. We assessed smartphone apps for snoring and concluded that apps recording, playing back, and graphically displaying snoring sounds can be potentially valuable clinical tools for patients and health care professionals. This study has garnered a broad response and was recognized as “Article of the Year” in *The Journal of Laryngology and Otology*.

We continue to explore how digital oral scanners, 3D printers, virtual surgical planning, and other leading edge tools can be incorporated in skeletal airway reconstruction. We are passionate about the advancement of imaging, automation, and digitization in the diagnosis, selection, and implementation of treatment for sleep-disordered breathing.



TRAINING

## One-of-a-Kind Programs to Teach Teachers and Sleep Surgery Practitioners Worldwide

We offer a unique one-year intensive surgical instructorship in sleep surgery. This program has been remarkably successful. With intense interest from otolaryngologists and maxillo-facial surgeons, all instructors who completed training at Stanford have been placed in academic positions across the country, including:

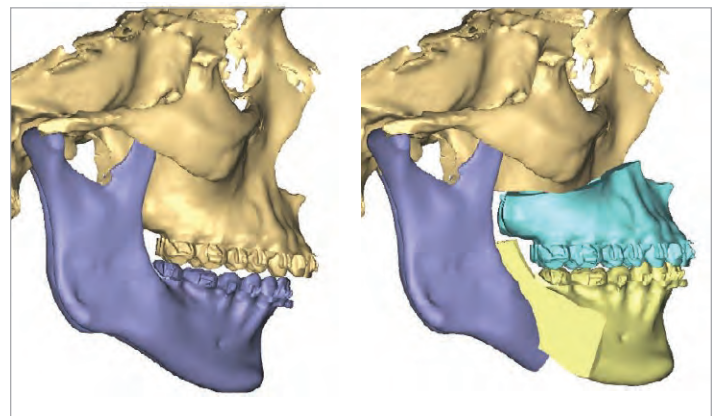
- Mount Sinai Medical Center, New York
- Stanford University, California
- Tripler Army Medical Center, Honolulu, Hawaii
- University of Miami, Florida
- University of Minnesota
- University of Southern California

To enlighten audiences of physicians about the advanced techniques performed at Stanford, Dr. Capasso and Dr. Liu are frequently invited to speak at meetings worldwide.

Over the past six years, more than 50 physicians from more than 20 countries have visited our center. Most spend two to four weeks with us, observing our work in the clinic

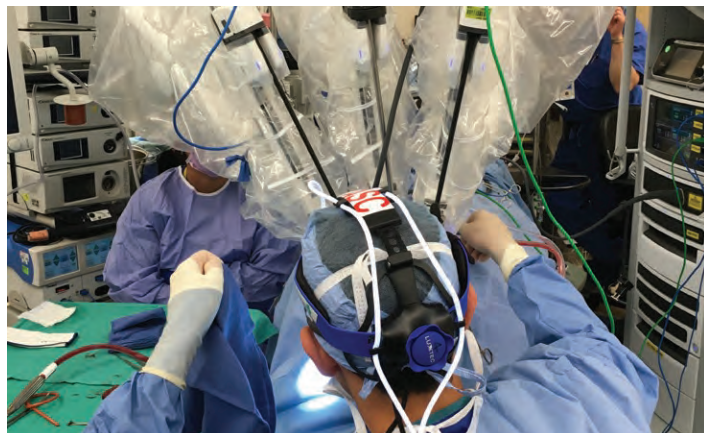
and the operating room. We also mentor two to three research scholars per year. They stay for one year and continue to collaborate with Stanford after returning to their home institutions.

We expect more clinical and research initiatives in the future, as we open our inviting new facility. The world’s only dedicated sleep surgery clinic, it houses four specialized exam rooms, a large procedure room, and a fully digitized



maxillofacial lab. This flagship facility is located adjacent to the Sleep Sciences and Medicine Center and its sleep lab.

Publishing extensively, training teachers, attending meetings worldwide, and inviting physicians to observe us in action—all these efforts magnify the reach of our expertise, with the singular aim that more patients will benefit from our experience and innovation.



## Success Stories

### Palate and tongue base surgery gives a patient his new breath of life

We know the profound impact that an individual's sleep disorder can have on that one person as well as an entire household. We strive to successfully diagnose and manage each and every case and, in the process, make patients and their families very happy.

Mr. G. presented to us with severe sleep apnea. "It got to the point where I stopped breathing in my sleep ... as frequently as once per minute!" Patients with moderate to severe sleep apnea have a significantly higher risk of heart attack or stroke: two to four times normal. Plus a five to seven times greater chance of having recurring automobile accidents. After a detailed analysis, our Sleep Surgery team discovered that Mr. G. had severe blockage at his palate and tongue levels.

Mr. G. had tried CPAP for three to four months, without success. He elected to have palate and tongue base surgery. Says Mr. G.: "It was a decision that has positively and dramatically transformed my life."

Within weeks of completing the surgery, Mr. G.'s overall fatigue (which had plagued him for more than 15 years) was nearly completely eliminated. He was then able to approach life with a vigor he says he had not had since

his 20s. Mr. G. poured that energy into taking spin classes, lifting weights, and competing in triathlons.

A final comment from Mr. G.: "The positive results from the surgery seemed to increase with each passing month. I had dramatically improved energy, mental clarity, and stamina. Being less tired, my appetite decreased, as did my weight. While I had always maintained a high level of physical activity, my workouts AFTER the surgery seemed to render far better results. I call it the power of SLEEP." His wife's reaction? "What Dr. Capasso did was magic."

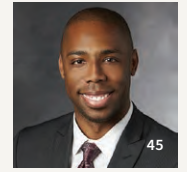
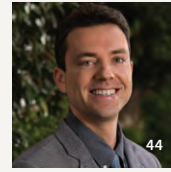
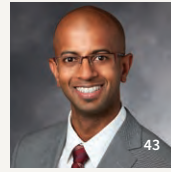
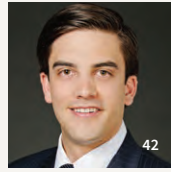
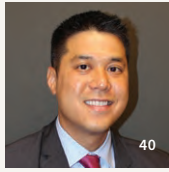
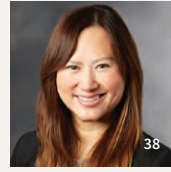
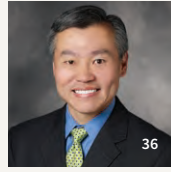
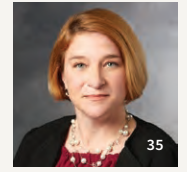
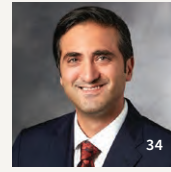
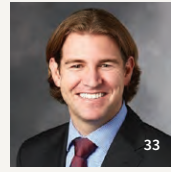
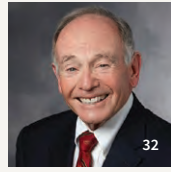
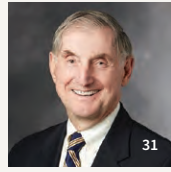
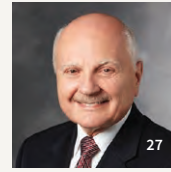
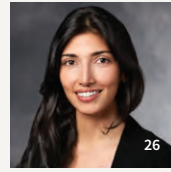
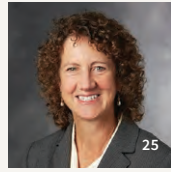
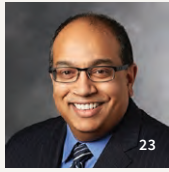
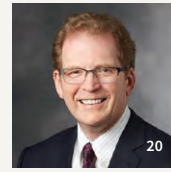
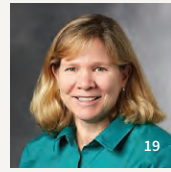
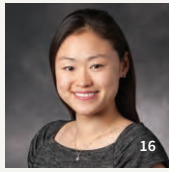
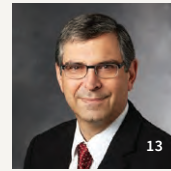
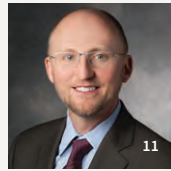
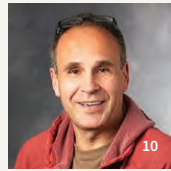
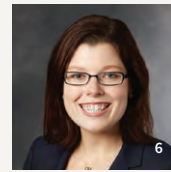
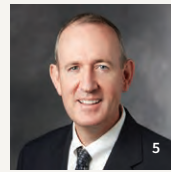


*In pre-op, age 50 (June 3, 2014)*



*At a triathlon, age 52 (July 24, 2016)*

# Faculty



## STANFORD MEDICINE PHYSICIANS

- Nikolas Blevins, MD**  
*Larry and Sharon Malcolmsen Professor of Otolaryngology and Professor, by courtesy, of Neurosurgery*
- Robson Capasso, MD, FAASM**  
*Assistant Professor of Otolaryngology – Head & Neck Surgery and Chief of the Division of Sleep Surgery*
- Kay Chang, MD**  
*Associate Professor of Otolaryngology – Head & Neck Surgery, and by courtesy, of Pediatric ENT*
- Alan G. Cheng, MD**  
*Associate Professor of Otolaryngology – Head & Neck Surgery and, by courtesy, of Pediatrics*
- Edward J. Damrose, MD, FACS**  
*Associate Professor of Otolaryngology – Head & Neck Surgery, Chief of the Division of Laryngology, and Chief of Staff of Stanford Health Care*
- Elizabeth Erickson-DiRenzo, PhD, CCC-SLP**  
*Assistant Professor of Otolaryngology – Head & Neck Surgery*
- Vasu Divi, MD**  
*Assistant Professor of Otolaryngology – Head & Neck Surgery*
- Matthew Fitzgerald, PhD**  
*Assistant Professor of Otolaryngology – Head & Neck Surgery*
- Nicolas Grillet, PhD**  
*Assistant Professor of Otolaryngology – Head & Neck Surgery*
- Stefan Heller, PhD**  
*Edward C. and Amy H. Sewall Professor, Otolaryngology – Head & Neck Surgery, Associate Chair for Research, and Professor and Vice Chair of Research Programs*
- Chris Holsinger, MD**  
*Professor of Otolaryngology – Head & Neck Surgery and Chief of the Division of Head & Neck Surgery*
- Peter H. Hwang, MD**  
*Professor and Vice Chair of Clinical Programs of Otolaryngology – Head & Neck Surgery, by courtesy, of Neurosurgery, and Chief of the Division of Rhinology and Endoscopic Skull Base Surgery*
- Robert K. Jackler, MD**  
*Chair of Stanford Otolaryngology – Head & Neck Surgery, Edward C. and Amy H. Sewall Professor in Otorhinolaryngology and Professor, by courtesy, of Neurosurgery and of Surgery*
- Michael J. Kaplan, MD**  
*Professor of Otolaryngology – Head & Neck Surgery and, by courtesy, of Neurosurgery*
- Peter J. Koltai, MD**  
*Professor of Otolaryngology – Head & Neck Surgery and, by courtesy, of Pediatrics*
- Jennifer Y. Lee, MD**  
*Clinical Assistant Professor of Otolaryngology – Head & Neck Surgery*
- Stanley Yung Liu, MD, DDS**  
*Assistant Professor of Otolaryngology – Head & Neck Surgery*
- Uchechukwu Megwalu, MD, MPH**  
*Assistant Professor of Otolaryngology – Head & Neck Surgery*
- Anna H. Messner, MD**  
*Professor and Vice Chair Educational Programs of Otolaryngology – Head & Neck Surgery and Chief of the Division of Pediatric ENT at Lucile Packard Children's Hospital Stanford*
- Lloyd B. Minor, MD**  
*Carl and Elizabeth Naumann Dean of the Stanford University School of Medicine, Professor of Otolaryngology – Head & Neck Surgery, and Professor, by courtesy, of Bioengineering and of Neurobiology*
- Sam P. Most, MD**  
*Professor of Otolaryngology – Head & Neck Surgery and Chief of the Division of Facial Plastic and Reconstructive Surgery*
- Mirna Mustapha, PhD**  
*Assistant Professor of Otolaryngology – Head & Neck Surgery*
- Jayakar V. Nayak, MD, PhD**  
*Assistant Professor of Otolaryngology – Head & Neck Surgery and, by courtesy, of Neurosurgery*
- John S. Oghalai, MD**  
*Professor of Otolaryngology – Head & Neck Surgery and, by courtesy, of Pediatrics and of Neurosurgery*
- Lisa A. Orloff, MD, FACS, FACE**  
*Professor of Otolaryngology – Head & Neck Surgery and Director of the Endocrine Head and Neck Surgery Program*
- Zara M. Patel, MD**  
*Assistant Professor of Otolaryngology – Head & Neck Surgery*
- Gerald R. Popelka, PhD**  
*Consulting Professor of Otolaryngology – Head & Neck Surgery*
- Anthony Ricci, PhD**  
*Edward C. and Amy H. Sewall Professor in Otolaryngology and Professor, by courtesy, of Molecular and Cellular Physiology*
- Robert Riley, MD, DDS**  
*Clinical Professor of Otolaryngology – Head & Neck Surgery*
- Eben Rosenthal, MD**  
*John and Ann Doerr Medical Director of the Stanford Cancer Center and Professor of Otolaryngology – Head & Neck Surgery and of Radiology (Molecular Imaging Program)*

- John Shinn, MD**  
*Clinical Professor of Otolaryngology – Head & Neck Surgery*
- George Shorago, MD**  
*Clinical Associate Professor of Otolaryngology – Head & Neck Surgery*
- Douglas Sidell, MD**  
*Assistant Professor of Otolaryngology – Head & Neck Surgery and Director of the Pediatric Aerodigestive Center and the Pediatric Voice and Swallowing Clinics at Lucile Packard Children's Hospital Stanford*
- Davud Sirjani, MD, FACS**  
*Clinical Assistant Professor of Otolaryngology – Head & Neck Surgery*
- Heather Starmer, MA, CCC-SLP, BCS-S**  
*Clinical Assistant Professor and Director of the Head and Neck Cancer Speech and Swallowing Rehabilitation Center*
- C. Kwang Sung, MD, MS**  
*Assistant Professor of Otolaryngology – Head & Neck Surgery*
- John B. Sunwoo, MD**  
*Associate Professor of Otolaryngology – Head & Neck Surgery*
- Mai Thy Truong, MD**  
*Clinical Assistant Professor of Otolaryngology – Head & Neck Surgery*

## STANFORD CLINICAL INSTRUCTORS

- Garret W. Choby, MD**  
*Clinical Instructor of Otolaryngology – Head & Neck Surgery*
- Steven S. Hong, MD**  
*Consulting Assistant Professor of Otolaryngology – Head & Neck Surgery*
- Sami Moubayed, MD**  
*Clinical Instructor of Otolaryngology – Head & Neck Surgery*
- Ryan K. Orosco, MD**  
*Clinical Instructor of Otolaryngology – Head & Neck Surgery*
- Andrew Thamboo, MD**  
*Clinical Instructor of Otolaryngology – Head & Neck Surgery*
- Yona Vaisbuch, MD**  
*Clinical Instructor of Otolaryngology – Head & Neck Surgery*
- Ryan Williams, MD**  
*Clinical Instructor of Otolaryngology – Head & Neck Surgery*

# Faculty Biographies

## STANFORD MEDICINE PHYSICIANS

**Nikolas Blevins, MD**, is the Larry and Sharon Malcolmson Professor of Otolaryngology in the School of Medicine and Professor, by courtesy, of Neurosurgery at Stanford School of Medicine. He serves as the Otology and Neurotology Division Chief and Fellowship Director, and is the Medical Director of the Stanford Cochlear Implant Center. His clinical focus includes caring for disorders of the ear and skull base, including hearing loss, infections, skull base neoplasms, and cranial nerve dysfunction. His research interests include the development of virtual environments to plan and rehearse complex surgical procedures using simulated dissections based on preoperative imaging. He is also developing new technologies, such as microendoscopy, to diagnose and treat challenging disorders of the inner ear.

**Robson Capasso, MD, FAASM**, is an Assistant Professor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine and is currently the Chief of the Division of Sleep Surgery. He is dual trained in both sleep medicine and sleep surgery, and has been an investigator on imaging and endoscopic modalities for pre-treatment evaluation, and surgical treatment of obstructive sleep apnea patients. Currently his research interests have a focus on clinical use of smartphone applications and consumer-based devices for sleep disordered breathing, biomarkers for obstructive sleep apnea, pre-surgical evaluation and upper airway changes after surgery in obstructive sleep apnea sufferers.

**Kay Chang, MD**, is an Associate Professor of Otolaryngology – Head & Neck Surgery and, by courtesy, of Pediatric ENT, at Stanford School of Medicine. His clinical interests are in congenital hearing loss, congenital ear anomalies, microtia and canal atresia reconstruction, and pediatric cochlear implantation. His research interests include neonatal hearing screening, genetics of hearing loss, otoacoustic emissions, and ototoxicity. Dr. Chang created the SIOP

Ototoxicity Grade, which has become the de facto international standard used for all Children’s Oncology Group (COG) and SIOP multi-institutional chemotherapy protocols, and directs several multi-institutional studies using protective agents to prevent hearing loss in children receiving cisplatin to treat their cancer.

**Alan G. Cheng, MD**, is an Associate Professor of Otolaryngology – Head & Neck Surgery and, by courtesy, of Pediatrics at Stanford School of Medicine. His clinical practice based at the Stanford Ear Institute and Lucile Packard Children’s Hospital Stanford focuses on otologic diseases including congenital hearing loss and cochlear implantation, and chronic ear diseases in the pediatric population. His research program studies inner ear stem cell biology and aminoglycoside ototoxicity. In particular, he is examining mechanisms of hair cell development and regeneration with the goal of restoring hearing loss. He also collaborates with Anthony Ricci, PhD, to design and create new and improved versions of aminoglycosides to eliminate the risk of hearing loss.

**Edward J. Damrose, MD, FACS**, is an Associate Professor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine, is Chief of the Division of Laryngology, and is Chief of Staff of Stanford Health Care. He is an expert in airway reconstruction and partial laryngectomy for laryngeal cancer. His clinical focus is on head and neck cancer, otolaryngology, laryngology, tracheal stenosis, vocal cord paralysis, laryngeal cancer, and hoarseness. His research is primarily interested in laryngeal physiology and function, with a particular interest in the application of advanced imaging techniques in studying vocal-fold physiology.

**Elizabeth Erickson-DiRenzo, PhD, CCC-SLP**, is an Assistant Professor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine. She directs the Laryngeal Research Laboratory—one of only a few dedicated

laboratories in the country that investigate the biology of laryngeal disorders. Her research uses techniques from basic and human clinical sciences to improve the prevention and management of laryngeal disorders, investigating how external factors such as inhaled pollutants, bacteria, and viruses affect laryngeal function. Clinically, she specializes in the evaluation and treatment of patients with voice, resonance, airway, and swallowing disorders.

**Vasu Divi, MD**, is an Assistant Professor of Otolaryngology – Head & Neck Surgery at the Stanford School of Medicine, Director of the Stanford Head and Neck Fellowship for the American Head and Neck Society, and a member of the Stanford Cancer Institute. Dr. Divi specializes in the treatment of head and neck cancer, as both a cancer surgeon and a reconstructive surgeon. He has a special interest in high-risk and advanced skin cancers, oral cavity cancers, and osteoradionecrosis of the head and neck. He uses advanced 3D modeling to customize reconstruction of the jaw following surgery for cancer or radiation injuries.

**Matthew Fitzgerald, PhD**, is an Assistant Professor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine. He serves as Chief of Audiology at Stanford, and oversees the Audiology departments of both Stanford Hospital and Lucille Packard Children’s Hospital Stanford. His research efforts are focused on better understanding the mechanisms by which individuals learn to understand speech or other sounds. He is also developing new tools or tests that audiologists can use to maximize outcomes with cochlear implants, investigating methods to facilitate language development in hearing-impaired children, and exploring treatments for tinnitus.

**Nicolas Grillet, PhD**, is an Assistant Professor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine. His basic science research explores the genetics of hearing and

vestibular impairment. The Grillet Lab's goal is to identify the comprehensive list of genes required for hearing and head motion detection, and ultimately characterize the function of these genes at the molecular level. To identify these genes, his research uses mouse models either to precisely inactivate candidate genes (Reverse Genetics) or to generate randomly mutated animals and screen them for hearing or vestibular defects (Forward Genetics).

**Stefan Heller, PhD**, is the Edward C. and Amy H. Sewall Professor in the School of Medicine, Otolaryngology – Head & Neck Surgery, Associate Chair for Research, and Professor and Vice Chair of Research Programs. His research focuses on regenerative approaches to repair the damaged cochlea. Dr. Heller employs molecular and single cell transcriptomic methods to study inner ear development and regeneration in various animal models. He works on developing stem-cell-based cellular assays and somatic cell reprogramming toward the development of novel cures for hearing loss.

**Chris Holsinger, MD**, is a Professor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine, and Chief of the Division of Head & Neck Surgery. He also leads the multidisciplinary Head & Neck Oncology Program at the Stanford Cancer Center. His surgical practice focuses on the surgical management of benign and malignant diseases of the thyroid, as well as head and neck cancers. His research interests include endoscopic head and neck surgery, transoral robotic surgery, and transoral laser microsurgery, as well as time-honored approaches of conservation laryngeal surgery, supracricoid partial laryngectomy.

**Peter H. Hwang, MD**, is a Professor and Vice Chair of Clinical Programs of Otolaryngology – Head & Neck Surgery and, by courtesy, of Neurosurgery at Stanford School of Medicine, and is Chief of the Division of Rhinology and

Endoscopic Skull Base Surgery. His clinical practice focuses on endoscopic sinus and skull base surgery. Dr. Hwang is currently the President of the American Rhinologic Society. He also serves as Associate Editor of the *International Forum of Allergy and Rhinology*. Dr. Hwang co-authored the award-winning textbook *Rhinology: Diseases of the Nose, Sinuses & Skull Base* and has authored or co-authored over 150 manuscripts and book chapters.

**Robert K. Jackler, MD**, is the Chair of Stanford Otolaryngology – Head & Neck Surgery, and the Edward C. and Amy H. Sewall Professor in Otorhinolaryngology and Professor, by courtesy, of Neurosurgery and of Surgery. A world leader in the management of tumors of the ear, temporal bone, and postero-lateral cranial base, he has authored seminal textbooks that have defined the scope and practice of neurotology, and has developed innovations designed to enhance exposure of inaccessible intracranial tumors located adjacent to the brain stem. His research includes founding Stanford Research into the Impact of Tobacco Advertising (SRITA)—an interdisciplinary collaboration involving faculty and trainees from medicine, history, and anthropology.

**Michael J. Kaplan, MD**, is a Professor of Otolaryngology – Head & Neck Surgery and, by courtesy, of Neurosurgery at Stanford School of Medicine. His clinical focus covers the full range of head and neck cancers, skull base tumors, salivary gland tumors, and parotid neoplasms. Dr. Kaplan's research explores new therapeutic approaches for head and neck cancer (immune stimulation and biological modifiers, etc.), and head and neck cancer stem cells.

**Peter J. Koltai, MD**, is a Professor of Otolaryngology – Head & Neck Surgery, and, by courtesy, of Pediatrics at Stanford School of Medicine. His clinical and academic

interests focus on expanding surgical options for pediatric obstructive sleep apnea and on the broader public health issue of lithium button battery injuries in children. He has established new techniques for the management of pediatric facial fractures, a novel method of tracheostomy, refinements in laryngotracheal reconstruction, and the development of microdebrider shaver blades for “powered” adenoidectomy and “partial” tonsillectomy. His research interests include treatments for pediatric obstructive sleep-disordered breathing.

**Jennifer Y. Lee, MD**, is a Clinical Assistant Professor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine, and serves as Clinic Chief of Adult Otolaryngology in the division of Comprehensive Otolaryngology. Her clinical interests include sinusitis, eustachian tube dysfunction, salivary gland tumors, endocrine tumors, oral masses, and neck tumors. Her research focus is in improving and developing education for the next generation of otolaryngologists through simulation and development of treatment outcomes of eustachian tube balloon dilation.

**Stanley Yung Liu, MD, DDS**, is an Assistant Professor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine, and serves as Co-director of the Stanford Sleep Surgery Fellowship Program and a preceptor for the Stanford Oculo-plastic Surgery Fellowship. In addition to the full scope of sleep apnea surgery (nasal, palatal, tongue-base, hypoglossal nerve stimulation, genioglossus advancement, maxillomandibular advancement), he has expertise in orthognathic surgery, facial bone contouring, and repair of complex primary and secondary facial trauma. His research focuses on dynamic airway changes after sleep surgery, applications of virtual surgical planning to facial skeletal surgery, and neuromodulation of the head and neck.

**Uchechukwu Megwalu, MD, MPH**, is an Assistant Professor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine, and works in the Division of Comprehensive Otolaryngology. His clinical interests include thyroid and parathyroid disorders, head and neck tumors, sinusitis, and chronic ear disorders. Dr. Megwalu conducts outcomes/health services research, with a focus on health literacy, health disparities, and comparative effectiveness research. He is exploring the use of large datasets—the SEER database—to evaluate the impact of sociodemographic and clinical factors on treatment choice and survival outcomes of those with head and neck cancer.

**Anna H. Messner, MD**, is a Professor and Vice Chair Educational Programs of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine, and Chief of the Division of Pediatric ENT at Lucile Packard Children's Hospital Stanford. She serves as Vice Chair and Chief of Pediatric Otolaryngology and Resident Program Director. She directs both the Velopharyngeal Insufficiency (VPI) and the Vocal Cord Dysfunction (VCD) clinics, focusing on evaluating and treating patients with and without cleft palate who suffer from disorders of the velopharyngeal valve, and patients for laryngospasm or paradoxical vocal cord motion during exercise. Her research covers post-tonsillectomy care, obstructive sleep apnea, ankyloglossia, and education of medical professionals at all levels.

**Lloyd B. Minor, MD**, is the Carl and Elizabeth Naumann Dean of the Stanford University School of Medicine. With his leadership, Stanford Medicine has established a strategic vision to lead the biomedical revolution in Precision Health with a focus on proactive, preventive, predictive, and personalized health care. Dr. Minor is also a professor of Otolaryngology – Head & Neck Surgery and a professor of Bioengineering and of Neurobiology, by courtesy, at Stanford University. With more than 140 published articles and chapters, Dr. Minor is an expert in

balance and inner ear disorders. In 2012, he was elected to the National Academy of Medicine.

**Sam P. Most, MD**, is Chief of the Division of Facial Plastic and Reconstructive Surgery and Professor of Otolaryngology – Head & Neck Surgery at the Stanford School of Medicine. His clinical focus encompasses aesthetic and functional/restorative facial surgery, including aesthetic surgery (rhinoplasty, revision rhinoplasty, facelift, blepharoplasty) as well as facial reconstruction. He is world-renowned in rhinoplasty and in forehead flap reconstruction of a missing nose. Through his research, he is exploring a higher standard of care for facial plastic surgery patients by developing tools for evidence-based medical practice and studying the efficacy and cost-effectiveness of various surgical procedures, as well as effects on quality of life for patients.

**Mirna Mustapha, PhD**, is an Assistant Professor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine. Her research and scholarly interests focus on understanding the cellular and molecular mechanisms underlying peripheral auditory neuropathy. Different types of auditory neurons exist. In addition to their morphological and functional differences, they differ in their vulnerability to aging and noise damage. Our team mission is to identify the genes and mechanisms that define the identity of these subtypes of neurons. Knowledge of these genes will provide direction toward understanding the etiology of noise-induced and age-related hearing impairment and developing therapeutic measures.

**Jayakar V. Nayak, MD, PhD**, is an Assistant Professor of Otolaryngology – Head & Neck Surgery and, by courtesy, of Neurosurgery at Stanford School of Medicine. He is also the Co-director of the Rhinology Fellowship Training Program at Stanford. His clinical practice includes endoscopic nasal and sinus surgery and skull base surgery, with a special interest in complex upper airway breathing conditions such as empty nose syndrome

(ENS). He is also a surgeon scientist, heading one of the few groups dedicated to nasal, sinus, and upper airway biology research at the basic, clinical, and translational levels. His group's main focus is to design novel treatment platforms for upper airway disease through understanding of stem cell biology and immune system abnormalities with chronic airway inflammation. Dr. Nayak was recently named the Gies Foundation Endowed Faculty Scholar for Food Allergy and Immunology Research to support his research endeavors.

**John S. Oghalai, MD**, is a Professor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine and, by courtesy, of Pediatrics and of Neurosurgery, and Director of the Stanford Children's Hearing Center and its pediatric cochlear implant team. He has developed a nationwide referral practice in the subspecialty care of patients with diseases of the ear and skull base, and an adult practice focused on the management of skull base tumors such as vestibular schwannoma (acoustic neuroma) and meningioma. The Oghalai lab's NIH-funded basic science/translational research efforts are designed to better understand the mechanisms of hearing loss, and clinical research approaches are targeted to directly and rapidly improve the care of patients with hearing loss.

**Lisa A. Orloff, MD, FACS, FACE**, is Professor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine, and Director of the Endocrine Head and Neck Surgery Program. She is an internationally recognized leader in endocrine head and neck surgery and in the application of ultrasonography to head and neck diseases. Her clinical practice focuses on surgical management of thyroid and parathyroid tumors, including advanced thyroid cancers. Dr. Orloff also studies thyroid cancer outcomes, genetics, and regeneration of tissue that has been lost as a result of cancer therapies.

**Zara M. Patel, MD**, is an Assistant Professor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine. She is also Co-



director of the Rhinology Fellowship, and Chair of the Education Committee for the American Rhinologic Society. She has developed a multitude of educational materials for both physicians and patients to help them better understand rhinologic disorders. She is an expert in advanced endoscopic sinus and skull base surgery, and her research interests include new techniques for endoscopic skull base surgery, sinonasal cancer, chronic rhinosinusitis, and olfactory dysfunction.

**Gerald R. Popelka, PhD**, is a Consulting Professor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine. Dr. Popelka is a co-inventor of the world's first all-digital hearing aid. The resulting patent forms the basis of every digital hearing aid—virtually all hearing aids currently produced worldwide. He has earned an international reputation for creating and using leading edge technology that addresses both basic science and clinical applications. He currently is focusing on basic auditory neuroscience and effective auditory neuromodulation treatment of tinnitus.

**Anthony Ricci, PhD**, is the Edward C. and Amy H. Sewall Professor in Otolaryngology in the School of Medicine and Professor, by courtesy, of Molecular and Cellular Physiology. He is a world-recognized expert in hair cell physiology. The research underway at the Ricci Lab focuses on the molecular mechanisms associated with hair cell mechanotransduction and synaptic transmission. He also collaborates with Dr. Alan Cheng on creating nonototoxic aminoglycoside antibiotics.

**Robert Riley, MD, DDS**, is a Clinical Professor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine. He is considered one of the internationally renowned pioneers in sleep apnea surgery. His clinical focus is on otolaryngology, and his research and publications have explored efficacy of maxillomandibular advancement with drug-induced sleep endoscopy and computational fluid dynamics airflow modeling, and resting energy expenditure in adults with sleep disordered breathing.

**Eben Rosenthal, MD**, is the John and Ann Doerr Medical Director of the Stanford Cancer Center and Professor of Otolaryngology – Head & Neck Surgery, and of Radiology (Molecular Imaging Program) at Stanford. He specializes in the treatment and reconstruction of head and neck cancer patients, and has a strong interest in development of new strategies to surgically repair complex head and neck defects to improve functional and cosmetic outcomes. Dr. Rosenthal has performed preclinical and clinical research on the role of targeted therapies for use to treat cancer alone and in combination with conventional therapy. He has served as principal investigator on several early-phase, investigator-initiated and industry-sponsored clinical trials in molecular oncology.

**John Shinn, MD**, is a Clinical Professor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine. For more than 40 years, he served as Chief of the Otolaryngology Department at Santa Clara Valley Medical Center, a Stanford affiliate. His clinical practice focused on otology and neurotology. Today, as part of the Stanford Ear Institute team, he has a clinical interest in neurobalance problems. His scholarly research publications have explored mandible fracture repair, T3 toxicosis due to non-metastatic follicular carcinoma of the thyroid, and the method for temporary reconstitution of the cervical esophagus, to name a few.

**George Shorago, MD**, is a Clinical Associate Professor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine. At the Stanford Ear Institute, he specializes in diagnosing and treating hearing loss, dizziness, ear infections, and tinnitus. He has practiced for more than 46 years, with a clinical focus on otolaryngology and medical otology. This also includes vertigo, sinusitis, hoarseness, swallowing problems, deafness, and other ear diseases.

**Douglas Sidell, MD**, is an Assistant Professor of Otolaryngology – Head & Neck Surgery, and Director of the Pediatric Aerodigestive Center and the Pediatric Voice and Swallowing

Clinics at Lucile Packard Children's Hospital Stanford. Dr. Sidell focuses on airway and pulmonary disorders in children; his surgical practice emphasizes complex and revision airway reconstruction, voice and swallowing disorders, and congenital or acquired abnormalities of the larynx and trachea. His current research investigates the management of vocal cord paralysis following cardiac surgery, novel treatments for airway obstruction, and the management of type 1 laryngeal clefts in children.

**Davud Sirjani, MD, FACS**, is a Clinical Assistant Professor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine, and serves as Chief of Otolaryngology at the VA in Palo Alto. He has pioneered the use of telemedicine to provide complicated head and neck cancer care to remote VA satellite locations across the Western U.S. As the Director of the salivary program at Stanford, he focuses on minimally invasive parotidectomy. He was the first surgeon at Stanford to offer patients sialendoscopy. His research interests include innovations in minimizing morbidity from parotid cancer treatment. He invented the only parotidectomy surgical simulator in the country—now used to teach other surgeons about the tension placed on the facial nerve during parotidectomy.

**Heather Starmer, MA, CCC-SLP, BCS-S**, is a Clinical Assistant Professor and Director of the Head and Neck Speech and Swallowing Rehabilitation Center at Stanford School of Medicine. She specializes in the rehabilitation of speech, voice, and swallowing in patients with head and neck cancer. She engages in clinical and research endeavors to optimize head and neck cancer outcomes and survivorship. Her research focuses on prevention of radiation associated swallowing disorders, strategies to enhance patient adherence to rehabilitation, and studying the functional impact of new cancer treatments.

**C. Kwang Sung, MD, MS**, is an Assistant Professor of Otolaryngology – Head & Neck

Surgery at Stanford School of Medicine. He specializes in voice, swallowing, and airway disorders. His clinical interests include the care of professional voice users; phonosurgery; treatment of vocal fold paralysis with laryngeal framework surgery and injection techniques; spasmodic dysphonia; office-based laser surgery; recurrent laryngeal papilloma; essential laryngeal tremor; and laryngeal cancer. His research interests include the development of office-based laryngeal surgical techniques and instrumentation, and clinical outcomes after treatment of glottic insufficiency and benign vocal fold pathology.

**John B. Sunwoo, MD**, is an Associate Professor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine. His clinical focus is on the surgical management of head and neck cancer, such as melanoma and neoplasms of the thyroid and parathyroid glands. He co-founded the Stanford Thyroid/Parathyroid Tumor Board; serves as the Director of Head and Neck Cancer Research; and is the principal investigator of an NIH-funded laboratory at the Stanford Cancer Institute. His research focuses on immune response to tumor-initiating cells, NK cell biology, and tumor heterogeneity.

**Mai Thy Truong, MD**, is a Clinical Assistant Professor, Otolaryngology – Head & Neck Surgery at Stanford School of Medicine in the Pediatric Otolaryngology Division. Along with Dr. Kay Chang, Dr. Truong oversees a dedicated Microtia and Atresia Clinic that includes the diagnosis, treatment, and education for microtia and the cosmetic and hearing needs of children. Drs. Truong and Chang are among the only American surgeons to have been personally trained by Dr. Françoise Firmin on the two-stage Firmin technique with rib cartilage graft. Dr. Truong's other interests include vascular anomalies and pediatric sleep apnea. Her research has explored silent sinus syndrome, beta-Adrenergic receptor expression in vascular tumors, and sleep endoscopy.

## CLINICAL INSTRUCTORS

**Garret Choby, MD**, is a Clinical Instructor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine. Dr. Choby's clinical focus includes chronic rhinosinusitis, endoscopic sinus surgery, endoscopic skull base surgery, and head and neck surgery. His research interests include surgical outcomes of endoscopic sinus surgery, CSF leak repair techniques, sinonasal manifestations of systemic disease, and technological advances in endoscopic skull base surgery.

**Steven S. Hong, MD**, is a Consulting Assistant Professor of Otolaryngology at Stanford School of Medicine. He has a special interest in benign and malignant tumors of the head and neck, and the complex reconstruction that comes with their treatment. Dr. Hong has a particular interest in utilizing surgical robots for teleassistive microsurgeries. He also has research experience related to fluorescence-guided surgery using molecularly targeted compounds and analyzing medicolegal outcomes and issues pertaining to head and neck surgery.

**Sami Moubayed, MD**, is a Clinical Instructor in the division of Facial Plastic and Reconstructive Surgery of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine. His clinical expertise and interests are rhinoplasty, facial reconstructive surgery, use of microvascular surgery for head and neck reconstruction after cancer defects including advanced 3D modeling, facial cosmetic surgery, facial non-surgical rejuvenation (botulinum toxin, fillers), and facial trauma repair. Dr. Moubayed's research interests include outcomes research in facial reconstructive surgery, clinical prediction score development, and prospective database creation in surgery.

**Ryan Orosco, MD**, is a Clinical Instructor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine. He has a special interest in benign and malignant tumors of the head and neck, and the complex reconstruction that comes with their

treatment. Dr. Orosco has a particular interest in large population databases to answer questions related to quality and effectiveness of cancer care in the United States. His other areas of research are related to fluorescence-guided surgery and robotic telesurgery.

**Andrew Thamboo, MD**, is a Clinical Instructor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine, with a focus in rhinology and anterior skull base surgery. Dr. Thamboo specializes in understanding nasal physiology. In particular, he is investigating the impact of the inferior turbinate on nasal physiology. He also collaborates with Drs. Hwang, Nayak, and Patel on a number of studies in various fields that include cancer care, management of sinusitis, and olfaction.

**Yona Vaisbuch, MD**, is a Clinical Instructor of Otolaryngology – Head & Neck Surgery at Stanford School of Medicine, with an emphasis in otology and neurotology. His clinical focus includes the surgical and radio-surgical treatments of skull base tumors, particularly acoustic schwannomas, cochlear implants and stapes surgery. Dr. Vaisbuch's research interests include acoustic schwannoma prognostic factors, middle and inner ear mechanics, and transnational medicine in robotics and e-health. He acted as the co-founder of "The MagiCapsule", a mobile biofeedback app designed to improve adult cancer patients' supportive care.

**Ryan Williams, MD**, is a Clinical Instructor of Otolaryngology at Stanford School of Medicine. Dr. Williams's clinical focus is in obstructive sleep apnea, sleep surgery, and facial trauma. His research interests include the role of ultrasound imaging in diagnosis and treatment of sleep apnea, facial skeletal surgery, virtual planning for obstructive sleep apnea, and myofunctional therapy.







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