Multidisciplinary Approach and Teamwork Improves Treatment of Skull Base Disorders

The Skull Base Program at the University of Washington Medical Center specializes in evaluating, diagnosing, and treating patients who have skull base tumors and other types of intracranial disease.

The skull base is the anatomical area that supports the brain. It’s composed of the bones that make up the floor of the skull, the paranasal sinuses, orbits, the bone containing the ear, and a collection of cranial nerves and blood vessels that pass through the region.

Because of its complexity in a tightly confined anatomical space, and because diseases affecting the skull base occur beneath the brain, in the past surgeons were unable to perform surgery in the skull base area. There would have been too much risk to delicate, vital structures.

The field of skull base surgery has benefited significantly from tremendous progress in biotechnology, and has evolved considerably from the early experiences in the 1980s. Advances in diagnostic, therapeutic, and constructive techniques now allow successful treatment of lesions deep within the skull base. Access to the involved areas is still challenging and requires intensive, as well as technologically sophisticated, approaches.

The UW Medical Center Skull Base Program treats a variety of disorders. Acoustic neuromas are one of the cranial base tumors commonly treated here. This condition involves a tumor that lies within the cerebellopontine angle, an area adjacent to the bone of the ear. Other skull base tumors include carcinoma of the nasal area or sinuses, benign tumors of dural tissue (meningioma), nerve tumors arising from Schwann cells, and blood vessel tumors.

The Skull Base Program is a collaborative effort among a number of surgical and medical specialists who are responsible for designing and executing rational approaches for managing skull base diseases. Given the complex nature of skull base anatomy and surgery, procedures are performed at UW Medical Center by a multidisciplinary team of neurosurgeons, neurotologists, sinus surgeons, head and neck surgeons, and radiation oncologists, among others.

The team uses leading-edge diagnostic techniques, both pre-operatively and intra-operatively. These techniques provide the anatomical information necessary to define the surgical plan in great detail.

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An acoustic neuroma is a tumor of the auditory nerve sheath. Because it arises from Schwann cells, it is actually not a neuroma, but a type of schwannoma.

Acoustic neuromas are usually suspected in someone who develops some loss of hearing in one ear, especially if it is accompanied by tinnitus and balance disturbances. In the rare case of inherited neurofibromatosis, both ears are affected. As the tumor grows, hearing is further eroded. Larger tumors may cause neurological deficits and headaches as well. There's also the danger of numbness or paralysis of the face. Some tumors grow large enough to become life-threatening by pressing on the brain stem. Some people with very small tumors may be asymptomatic.

Dr. Larry Duckert, a UW Medicine neurotologist with a clinical and research interest in acoustic neuromas, said that between 2,000 to 3,000 of these non-cancerous tumors are diagnosed in the United States each year. They are diagnosed by documenting the hearing loss through an audiogram, followed by an MRI. A tumor less than 2.5 centimeter is considered small. Tumors can be as large as 4 or 5 centimeters.

Treatment for acoustic neuromas depends on their size, rate of growth, location, and expected treatment, Duckert said. The age of the patient, and the amount of hearing affected, may also affect treatment decisions. The risk of total hearing loss in the ear from surgery depends on the size and location of the tumor. UW Medicine’s multidisciplinary approach to acoustic neuromas, and its experience in treating this disorder, enables patients to obtain the treatment most suited to their case.

Sequential imaging and observation may be suitable for some small asymptomatic tumors. Treatments for larger or growing tumors may involve sharply focused radiation therapy to shrink the tumor and stop its expansion or microsurgery to resect and excise the tumor.

Duckert mentioned several improvements in the diagnosis and treatment of acoustic neuromas. The ability of MRI to detect tumors while they are still small has made a difference in preserving hearing and reducing the incidence of surgical complications such as nerve damage. Intraoperative monitoring of nerve function may also play a role in preserving hearing and protecting facial nerves. Neuronavigation devices now guide the surgeons through real-time 3-D anatomical images of the head and the area of the brain where they will operate. Development of minimally-invasive surgical procedures and advances in microsurgery have decreased morbidity from treatment.

If protection of hearing is the desired aftermath of surgery or if the tumor is large, the brain is retracted during surgery. Otherwise, a surgeon might be able to perform the surgery through the ear canal. Some patients say that restoration of balance compensates for the loss of hearing. UW Medicine rehabilitation specialists assist patients improve their sense of balance after surgery.

Gamma Knife® treatment is an option for some cases of acoustic neuromas.

UW Medical Center Has Excellent Track Record in Treating Acoustic Neuromas

Auditory brain stem response evaluation

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SKULL BASE DISORDERS from page 1

In addition to CT and MRI, computerized neuronavigational systems locate disease in the skull base and guide surgeons in 3-D space. The most technologically advanced microscopes, drills, endoscopes, and fiber optic systems are used in removing diseased tissue. Modern imaging techniques give surgeons a 360-degree panoramic view inside the skull. A complex, computerized intra-operative monitor assists the surgeons during the operation. Careful monitoring helps reduce injury to collateral brain and nerve tissue.

Usually skull base surgical procedures are minimally-invasive, with either no incision or a very small incision, and avoid significant manipulation of parts of the brain, which, if damaged, could result in a neurological deficit. Minimally-invasive procedures shorten operation times, reduce length of stays, and improve outcomes overall.

When appropriate, more invasive procedures are recommended. Treatment choices depend on the type and location of the problem, the patient’s symptoms and their duration, and the age and health of the patient. Skull base surgery is not just for tumor treatment. Skull base surgery may also be indicated to repair the skull after trauma, to manage vascular disorders including aneurysms, to remove benign cysts, and to treat infection.

TREATING ACOUSTIC NEUROMAS from page 2

neuroma. (See Sidebar on this page)

UW Medicine has an excellent track record in treating acoustic neuromas, because of its facilities, resources, experienced providers and multidisciplinary team approach. Up to 50 cases from the five-state region of Washington, Wyoming, Alaska, Montana, and Idaho are treated at UW Medicine each year.

“We can offer patients with this tumor options from an entire spectrum of treatment alternatives,” Duckert said. “Patients are given a sound basis on what they might expect as a result of different treatment approaches.”

Our philosophy of treatment combines conservative case management with state-of-the-art procedures and technology. Treatment is individualized in all cases and is designed to provide the most optimal outcomes: patient survival, quality of life, and maximal preservation of neurological function.

Not all skull base tumors or other disorders require surgical intervention. Other treatment modalities are available through the Skull Base Program. These include radiation therapy delivered, after 3-D treatment planning, by either stereotactic means or by a gamma knife. Chemotherapy may also be prescribed in combination with other forms of disease management.

When dealing with diseases of the skull base it is important to choose a team with a wealth of combined experience. The Skull Base Program team has combined their multidisciplinary expertise to successfully treat hundreds of patients. This highly skilled team is committed to providing the best care for each individual patient in a caring and compassionate environment.

For more information on the UWMC Skull Base Program, please call 206-598-8896.

To refer a patient to the UWMC Skull Base Program, please call Neurotology at 206-598-7521, or Neurosurgery at 206-598-9461, or download our consultation request document from: www.uwENT-headneck.org.

GAMMA KNIFE® THERAPY: An Option for Some Acoustic Neuromas

A Gamma Knife® stereotactic radiosurgery system can deliver radiation therapy precisely to an acoustic neuroma, while sparing the surrounding, normal tissue. A 3-D image of the treatment target is created from head scans taken with an MRI, CT scan or other imaging technique. The 3-D lesion configuration is analyzed to plan how to direct hundreds of gamma beams in a conformation that matches to the tumor’s shape and volume.

The patient’s head is held rigid by a fixed frame to keep it in an unchanged position. Radiation dosage depends on the lesion pathology, location, size, and prior treatments. This outpatient treatment has minimal pain and is usually completed in one session. The tumor’s growth is halted, and it may shrink over several months to years. The technique is called stereotactic radiosurgery.

“Too many times any hearing loss is attributed to old age or family predisposition,” Duckert said. He suggested that hearing loss be documented to determine if brain imaging may be the wise next step. The sooner an acoustic neuroma is detected, the easier it is to treat with fewer complications.

“The goal of Gamma Knife therapy,” said Jason Rockhill, assistant professor of radiation oncology and neurological surgery, “is to stop the tumor from growing and possibly shrink it over time.” UW Medicine’s Gamma Knife therapy system is located at Harborview Medical Center.

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Brain Stem Implants Bypass Auditory Nerve to Help Deaf to Hear

For a cochlear implant to work, the auditory nerve must be able to transmit electrical impulses that the brain can interpret as sound. Patients whose auditory nerves have failed because of disease or damage have no way to channel sound impulses to the brain.

A newer device, called an auditory brain stem implant can, in some cases, overcome this obstacle by delivering signals directly to the brain stem nucleus. Dr. Jay Rubinstein, who practices otolaryngology at UW Medical Center and Children’s Hospital and Regional Medical Center, has introduced auditory brain stem implant surgery to the Seattle area. Patients living in the Northwest no longer have to travel to Los Angeles for the implant procedure.

Rubinstein directs the Virginia Merrill Bloedel Hearing Research Center at the University of Washington, where he researches ways to improve implants that help people hear. The House Ear Institute in Los Angeles designed the first commercial auditory brain stem implant about 10 years ago, while original ABI research at House began in the 1970’s. Rubinstein helped develop the implant procedure at the University of Iowa Hospital Clinics, one of nine trial sites in the United States and abroad.

A person who has had an auditory brain stem implant wears a microphone behind the ear and carries a speech processor, usually placed in a pocket. Tape or a magnet holds a transmitting coil onto the side of the head. The coil receives impulses from the speech processor and sends a radio signal to a decoding chip inside the head. In turn, the chip transmits an impulse to an electrode that has been placed on the brain stem nucleus. The latest devices have 16 channels, compared to older models which had eight. The patient’s brain interprets the impulse as sound. Making sense of various sounds takes patience and practice.

Rubinstein explained that the auditory brain stem implant doesn’t work as well as a cochlear implant. For example, most people with a cochlear implant, but only a few people with auditory brain stem implants, can talk on the phone. The auditory brain stem implant more often serves as an aid to lip reading. About 15 percent of those receiving the auditory brain stem implant stop using it because, for them, it had little benefit.

“The auditory implant does make the patient notice important environmental signals, such as doorbells, horns, sirens or smoke alarms,” Rubinstein said.

Whether patients who have implants to help them hear, can also enjoy music is a big question, Rubinstein said, and one that his lab is trying to answer. One of the nation’s first people to receive an implant during its experimental phase in Iowa was able to hear his daughter play the violin. He probably heard poorly, Rubinstein said, but it brought tears to his eyes.

In the United States, auditory brain stem implants have been performed in adults who could hear earlier in their lives. If an adult has never heard, Rubinstein said, the device won’t work.

The device is usually placed during the same surgery conducted to remove a tumor from the auditory nerve. A neurosurgeon and otolaryngologist work collaboratively during this type of skull base surgery. Determining the right location to place the electrode in the brain stem nucleus is a delicate procedure. Surgeons and audiologists together perform an intraoperative electrophysiological test to locate the exact spot where an electronically-evoked auditory response can be obtained. A tiny stimulator is moved around in the likely vicinity until the sought-after response occurs and is distinguished from any electrical artifacts. The recording is in some ways similar to the hearing test given outside the skull to newborn babies.

After the device is in place, radiological images are taken to document its location. If a patient has tumors in both ears, but still has residual but declining hearing in one ear, the implant can remain turned off in the deaf ear until it is needed.

About 200 auditory brain stem implants have been performed in the United States, and about an equal number in Europe.

“Electronic implants to restore hearing are still in their infancy,” Rubinstein said. “There is tremendous potential in this field to give people who have become deaf their best chance to hear again.”

For more information on the auditory brainstem implant or other otologic implants (Cochlear Implant or Baha implant), please call 206-598-8896.

To refer a patient for possible implant candidacy, please call 206-598-7522, or download our consultation request document from: www.uwENT-headneck.org
A new skull base surgery training laboratory at the University of Washington (UW) provides opportunities for residents, fellows, and practicing surgeons to learn the latest techniques in skull base surgery. The wet lab can be set up to have four or five stations, resembling virtual operating rooms, where neurosurgeons, otolaryngologists and related surgical specialists can practice, on cadavers, state-of-the-art techniques in microsurgery, minimally-invasive endoscopy and standard skull base surgery. Trainees learn to use the latest surgical tools available for performing skull base procedures. In addition, the training center has a temporal bone lab for studying the complex anatomy of this region of the brain. The lab is under the direction of Dr. Robert Rostomily, associate professor of neurological surgery at UW Medical Center.

Rostomily mentioned that the UW School of Medicine also has surgery simulators for trainees wanting to become familiar with the basic techniques of endoscopic surgery. These simulators use robotics, virtual reality, anatomical models, computerized mannequins and other hands-on training systems.

The goal, Rostomily said, is to integrate modular training in skull base surgery into the program for residents and fellows in several specialties. He also hopes to develop an online library of videos demonstrating surgical techniques and actual surgeries.

Research Directions

Research in neurophysiology by Dr. John Oakley, acting instructor in neurology, and his colleagues is forming the scientific basis for monitoring skull base treatment outcomes. The UW will maintain a patient database to review the effects of treatment on hearing and other nerve functions. By collecting this data, researchers hope to develop a protocol for tracking and improving patient outcomes from skull base treatment.

Work is also under way to try to discover better treatments for estesioneuroblastomas and meningiomas. Rostomily explained that some tumors have receptors for triatide molecules. Researchers hope to detect these receptors more precisely and perhaps develop treatments using radioactive labeled substances that bind to these receptors.

Rostomily also pointed to the need to find novel treatments for skull base tumors, in addition to what is now available in surgery and radiation therapy. When a tumor can’t be completely removed, and when the patient has reached radiation limits, the patient has no other options if treatment fails, Rostomily said. That’s why he and his research team study the molecular biology of tumors to uncover the factors that predict life-endangering tumor behaviors, such as fast, invasive growth. This knowledge might lead to new therapies that target these factors.

Dr. John Silber, research associate professor of neurological surgery, and his colleagues are seeking genes that might be associated with the failure of some skull base tumors to respond to therapy. He measures differences in how tumor cells repair DNA damaged by radiation. Some skull base tumors tend to be locally aggressive. Silber’s lab is determining what factors cause tumors to grow rapidly in the final stages of disease, and what has changed from the time of treatment.

Overall, Rostomily said the purpose of research on skull base tumors is to ascertain additional ways to manage these cancers to prevent treatment failure.

“We have two strong arms for treating skull base tumors – radiation therapy and surgery – but we are missing the third arm, which, in managing many other forms of cancer, is chemotherapy,” Rostomily said. “We need to discover additional avenues for treating aggressive skull base tumors.”

For more information on skull base research and training developments, please call 206-598-9461.
Otolaryngologists and Neurosurgeons

Team Up to Remove Skull Base Tumors

At the UW Medical Center Skull Base program, patients undergoing surgery for tumors often benefit from the shared expertise of a neurosurgeon and an otolaryngologist/head and neck surgeon. One example of such a team is Dr. Neal Futran, a UW Medical Center otolaryngologist/ head & neck surgeon, and Dr. Robert Rostomily, a UW Medical Center neurosurgeon. Together they remove tumors lying in the anterior and mid-skull region.

Such tumors were typically removed by entering the skull base from the top of the head, during a craniotomy, or through an incision made under the lips and through the nose. Now surgeons can reach some of these tumors without making an incision entering directly through the nose. This approach has been made possible by the development of surgical telescopes, precision drills, endoscopes, and imaging techniques that allow surgeons to navigate safely around the anterior and middle skull base.

“We treat a variety of malignant and benign skull base tumors in this way, but the most common are pituitary tumors and meningiomas,” Futran said. Calling himself “the set up guy,” Futran exposes the appropriate area of the skull base by creating an optical window into the operating field. He does this by inserting visualization instruments through the nose. Rostomil then removes the tumor endoscopically after being guided to the right spot.

Because the pituitary dangles in space behind the bridge of the nose, pituitary tumors are the easiest to visualize, navigate to and remove using this method. More sophisticated tools and techniques are needed to treat more complex tumors.

“In these cases,” Futran said, “new intra-operative navigational systems – which are like a global positioning system for the skull base – are critical tools. We might be working in the delicate area between the eyes, around the carotid artery, or near cranial nerves. Some navigational tools allow us to look all around an interior cavity or view vital structures so that we can preserve these structures while taking out the tumor.” Because the approach through the nose doesn’t put excessive pressure on the brain or major nerves, the patient has a better chance of avoiding nerve damage, double vision, vision loss, or loss of smell.

Careful resealing of the skull base is performed after tumor removal to prevent fluid leakage and infection.

Advantages of these new forms of surgery are reduced odds of surgical trauma to the brain, a decreased hospital stay (in comparison to older procedures), fewer side effects and no visible scars. The patient awakens from surgery feeling nasal congestion (because of the packing), and some soreness. When the packing is removed one or two days later, the patient rinses the nasal passages with salt water for a few days to reduce swelling.

“Having a neurosurgeon and ENT work together on removing certain kinds of tumors and reconstructing the skull base provides the best results for patients,” Futran said. “This collaboration in minimally-invasive procedures has led to dramatic improvements in treatment.”

For more information on the UWMC Skull Base Program, call 206-598-8896.

To refer a patient to the UWMC Skull Base Program, please call Otolaryngology/Head-Neck Surgery at 206-598-7521 or Neurosurgery at 206-598-9461, or download our consultation request document from: www.uwENT-headneck.org

U-Link

When you refer your patients to UW Medical Center, you can access their medical records via the Internet.

Call 206-598-5693 or visit the “Info for Healthcare Professionals” section of uwmedicine.org for information about U-Link.

MEDCON

A consultation and referral service of the UW School of Medicine and its primary academic medical centers. The MEDCON line is open 24 hours-a-day, seven days-a-week. Call 1-800-326-5300 or e-mail medcon@washington.edu

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Otolaryngology / Head & Neck Surgery Center

Neurotology Program

Vibha Sharma 206-598-7521
Jenny Stork 206-598-7522
Fax 206-598-6611
Center Main Number 206-598-4022

Neurosurgery

Patient Care Coordinator:
Julie Allman 206-598-9461
Fax 206-598-2475
Clinic Main Number 206-598-5637

Gamma Knife Center

(Harborview Medical Center)

Scheduling Coordinator 206-731-8067
Fax 206-731-6008
Center Main Number 206-731-8076

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1959 N.E. Pacific Street

Box 357115

Seattle, WA 98105

206-598-7200

www.uwENT-headneck.org