

Neurological and Spine Surgery in the New Millennium

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The twentieth century has had a profound influence on medicine as we know it today. Innovation in research and advances in technology have provided avenues

to explore most aspects of health and disease. Neurological surgery—a field of medicine that addresses disorders of the brain, vertebral column, and peripheral nerves—is but one example of a specialty that arose and developed within the last hundred years. The new millennium offers momentum to further our understanding of the central and peripheral nervous systems, and neurosurgery will be a significant partner at the forefront of this work.

Neurosurgical Foundations

Through the first quarter of the twentieth century, most disease or trauma of the brain and spinal column were deemed untreatable. But beginning in the 1930s, physicians began to develop a better understanding of the anatomy and physiology of the nervous system and its adjacent regions. Likewise, surgeons began to successfully enter and navigate within these structures. Aided by advances in optics,

anesthesia, imaging, and basic research in neuroscience, today's neurosurgeons routinely perform operations that would have seemed fictional only a few decades ago.

Intracranial Surgery

Intracranial surgery represents the most striking example of this evolving technology. Neurosurgeons now have the training and tools to tackle the most difficult of vascular, tumor-related, and congenital problems in both adults and children.

Imaging has evolved to the degree that nearly all intracranial pathology can

be accurately localized, and in more than 75% of all cases a presumptive diagnosis can be considered even before surgery.

Neurovascular embolization of the blood supply to many of these

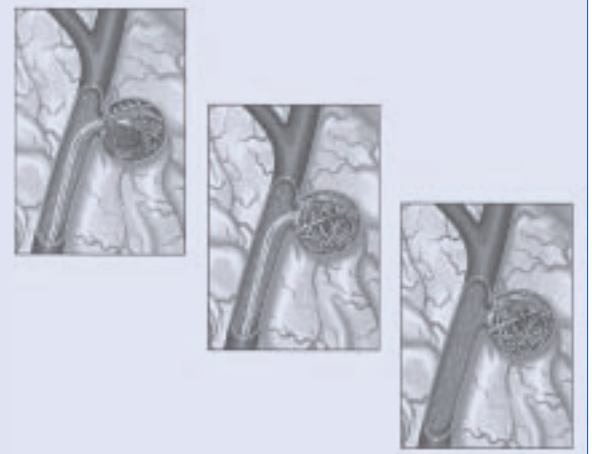


Image courtesy Boston Scientific Target Therapeutics

For unstable patients or patients with aneurysms that cannot be obliterated due to their location, an aneurysm coil can be inserted to alleviate risk of immediate rupture.



Image courtesy Mizuho America

A clip, above, is most often used in the treatment of aneurysms.

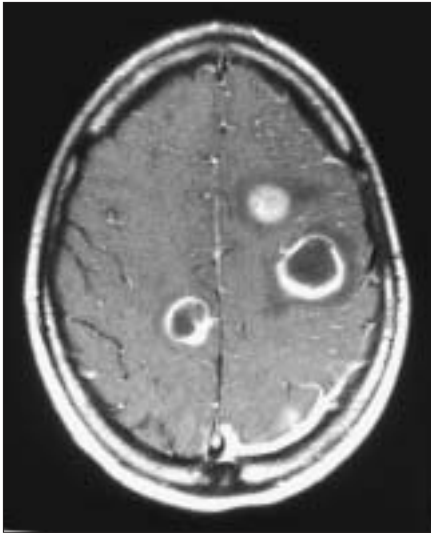
tumors and vascular lesions can diminish intraoperative bleeding, facilitating a more complete removal with less chance of complications.

These neurovascular techniques can be of great value in the treatment of vascular diseases of the brain. Although surgical clipping of aneurysms remains the preferred treatment, many cannot be obliterated due to their location or, in some cases, because of the poor medical condition of the patient. In selected patients for whom surgery is not an option, it is possible to place special coils within an aneurysm and

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Advances in imaging have been an invaluable tool for neurosurgeons. Left, an MRI reveals several metastatic lesions within the brain. Right, an MRI shows a compression fracture in the lumbar spine.

eliminate the risk of immediate rupture. Cerebral angioplasty is also available to address vasospasm of the intracranial vessels often associated with this type of hemorrhage. This has significantly improved the ultimate outcome in many of the patients who would have suffered severe impairment or death secondary to this catastrophic event.

Stereotactic Surgery

Stereotactic frame systems combined with CT or MRI scanning can identify regions of the brain with the accuracy of a millimeter or less. This allows for precise diagnostic biopsy with minimal risk of nearly all areas. Stereotactic surgery also allows the placement of specific thermal lesions or implantation of stimulating electrodes into the central regions of the brain. The latter two applications have been instrumental in the development of alternative surgical treatments for Parkinson's Disease and other related movement disorders.

Stereotactic technology has also resulted in a more aggressive approach to intracranial tumors and infections, and significantly improved patient survival rates have also been achieved. Neuro-surgeons now supplement

the surgical treatment of many tumor recurrences with chemotherapy or immunotherapy directed specifically at individual tumor cells. Within a year, our Gamma Knife Radiosurgery Center here in Las Vegas will begin to treat selected tumors and vascular lesions deep within the brain, as well as potentially offer an alternative treatment for some types of chronic pain syndromes.

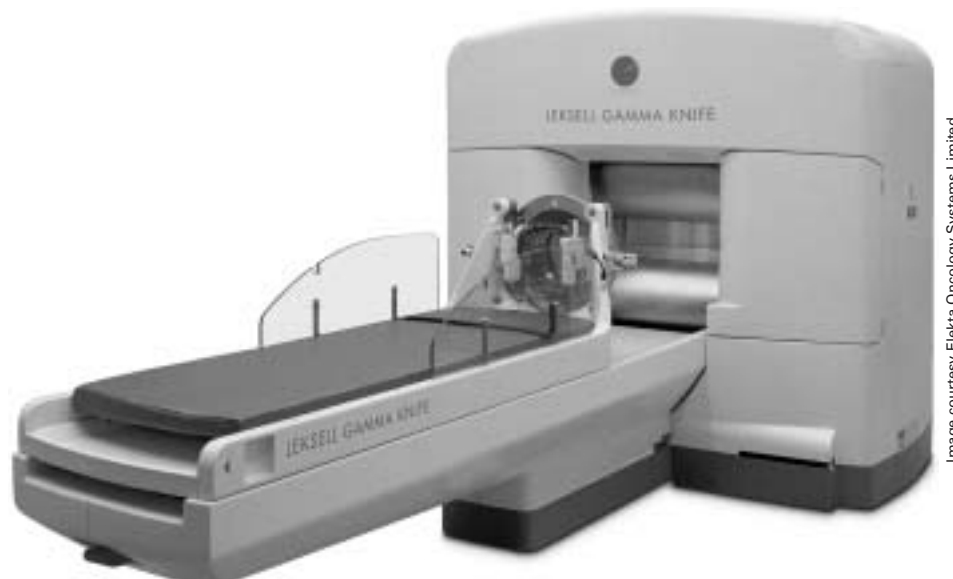
Frameless stereotactic neurosurgical technology has now become commonplace in the neurosurgical operating

room. Stereotactic surgery has allowed not only lesion localization, but also the ability to identify both normal and abnormal structures within the brain in "real time" during neurosurgical procedures. This has significantly diminished the operative morbidity of the resection of many complex lesions. Neurosurgeons can now also endoscopically visualize the brain's ventricular (fluid) system. This facilitates the removal of lesions from within some of the most eloquent regions of the brain, as well as the placement of cerebrospinal fluid shunting devices in a minimally-invasive fashion.

Vagal Nerve Stimulation

A simple outpatient procedure has dramatically changed the management of many intractable seizure disorders. Now some of the most severe epileptic conditions are treated with Vagal Nerve Stimulation (see *Western Neurosurgery Review*, Fall 1999). This technology is similar to procedures used to precisely stimulate regions of the spinal cord and peripheral nerves or to deliver precise

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The Gamma Knife, a type of stereotactic frame system, provides the means to target individual tumor cells and vascular lesions deep within the brain as well as offers a treatment alternative for some types of chronic pain syndromes.

Image courtesy Elekta Oncology Systems Limited



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Western Neurosurgery REVIEW

Western Neurosurgery Review is published by Western Regional Center for Brain & Spine Surgery for the practice's referring doctors and their staffs.

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amounts of medication within the nervous system—both of which are used to more effectively manage issues of chronic pain.

Spinal Surgery

Throughout much of the past millennium, neurosurgery laid the foundation for the development of our current understanding of spine surgery. Many delicate techniques, initially applied to brain surgery, are used by neurosurgeons today in performing most spinal operations. We can now address many uncomplicated spine problems with minimally invasive or other outpatient procedures. Intra-operative spinal monitoring, ultrasound, and frameless stereotactic guidance are among the neurosurgical technologies that allow us to approach and safely

remove tumors, infections, and both acute and degenerative lesions within or surrounding the neural elements. Successful neurosurgical reconstruction of the spine is commonplace and is accomplished with minimal complications and a high degree of success.

Conclusion

As we enter the twenty-first century, our goal is to remain at the forefront of the development and dissemination of this evolving knowledge and technology. The Western Regional Center for Brain & Spine Surgery is dedicated to bringing the best neurosurgical care available to southern Nevada and its surrounding communities.



This angiogram, another development in imaging technology, shows an arteriovenous malformation (AVM). AVMs are often treated with surgery, but inoperable AVMs may be treated with the Gamma Knife.