Cleveland Clinic

Outcomes 2006

Neurological Institute

Cover photograph by Tom Merce

Outcomes | 2006

Quality counts when referring patients to hospitals and physicians, so Cleveland Clinic has created a series of outcomes books similar to this one for its institutes and departments. Designed for a health care provider audience, the outcomes books contain a summary of our surgical and medical trends and approaches; data on patient volume and outcomes; and a review of new technologies and innovations. We hope you find these data valuable. To view all our outcomes books, visit Cleveland Clinic's Quality Web site at clevelandclinic.org/quality/outcomes.

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Neurological Institute
Chairmen's Letter


Michael T. Modic, M.D., F.A.C.R.


William Bingaman, M.D.

Dear Colleagues,

Nearly a year ago, we realigned the traditional departments involved in the neurosciences to create the Cleveland Clinic Neurological Institute. In taking this bold step, we created a fully integrated entity with a disease-specific focus, combining all physicians and other healthcare providers in neurology, neurosurgery, neuroradiology, psychiatry, the behavioral sciences and nursing, who treat children and adults with neurological and neurobehavioral disorders.

We believe this reorganization improves patient care, facilitates treatment decision making and streamlines multidisciplinary consultation for complex cases. Fully integrating specialties along disease lines has created an exciting synergy among Neurological Institute physicians who share similar clinical, research and educational interests, to the benefit of patients and physicians alike.

Our electronic medical record system gives us a powerful, institute-wide patient database that facilitates research and outcomes assessments in ways not previously possible. Patient functional status is assessed systematically, allowing us to better define outcomes and, importantly, create a feedback loop for continuous improvement in patient care.

As a result of this new structure, patients referred to the Neurological Institute receive comprehensive care more quickly and, ultimately, benefit from our evidence-based approach to treatment. We continue to consider you as a partner in patient care and anticipate you will find communications regarding their treatment options, decisions and clinical trial availability significantly improved.

Continued on next page

The creation of a Neurological Institute also offers exciting advantages and fresh opportunities for physician education. Neurological specialties and subspecialties are rapidly evolving as research expands our knowledge and sets new standards of care. We believe integration of all clinical areas into a Neurological Institute enhances our residency and fellowship programs by ensuring participants are exposed to new discoveries from all related disciplines. These future leaders in the field will benefit from the interdisciplinary clinical approach and research opportunities encountered daily at the Neurological Institute.

This is an exciting time to be involved in the neurosciences. Major advances in the treatment of brain tumors, epilepsy, mood disorders, stroke, pain and spinal disorders are improving quality of life and survival for thousands of patients. Yet, some diseases are still resistant to available treatments. We believe the innovative model of medicine created with the Neurological Institute will speed research and advances in treatment, resulting in better clinical care and more rapid breakthroughs in the full range of neurological and behavioral disorders.

Michael T. Modic, M.D., F.A.C.R.
Chairman, Neurological Institute

William Bingaman, M.D.
Vice Chairman, Neurological Institute

Iain H. Kalfas, M.D.
Chairman, Department of Neurological Surgery

Kerry Levin, M.D.
Chairman, Department of Neurology

Thomas Masaryk, M.D.
Director, Center for Neuroradiology

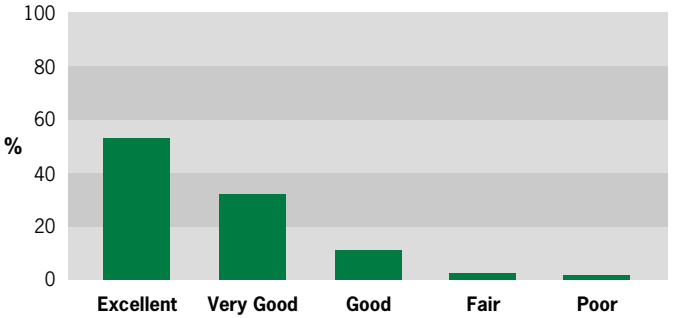
George E. Tesar, M.D.
Chairman, Department of Psychiatry and Psychology

Neurological Institute

Patient Experience

We ask our patients about their experiences and satisfaction with the services provided by our staff. Although our patients are already indicating we provide excellent care, we are committed to continuous improvement.

Inpatient
Overall Rating of Care

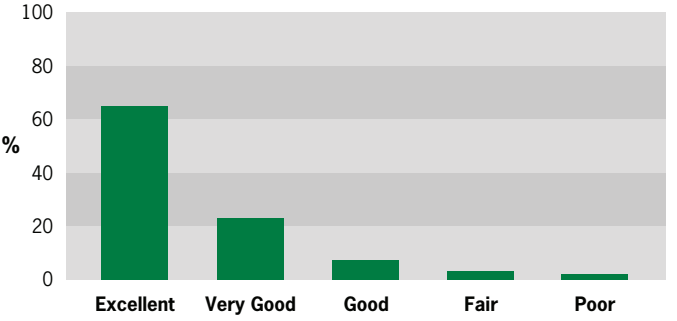


A Note Regarding H-CAHPS, the New National Standard for Reporting Hospital In-Patient Experience of Care:

The service excellence data displayed here shows results from an external patient experience survey administered for Cleveland Clinic.

A new national standard patient experience survey instrument called H-CAHPS was instituted across the country on October 1, 2006. Public reporting of initial results on CMS's Hospital Compare website is anticipated in late 2007. Accordingly, Cleveland Clinic outcomes booklets will transition to reporting H-CAHPS inpatient service excellence results in 2007.

Outpatient
Overall Rating of Care



Neurological Surgery
Department Overview

Iain H. Kalfas, M.D., Chairman

- One of the largest and most diverse academic neurosurgical programs in the United States.
- Ranked fifth in the country and best in Ohio by *U.S.News & World Report*.
- Integrates resident training, academic endeavors and research.
- Largest basic and clinical research program in hydrocephalus in the United States, funded by the National Institutes of Health and industry partners.
- Cerebrovascular Research Laboratory focuses on cerebral aneurysm treatment, imaging research, blood-brain barrier function and cerebral hemorrhage management.
- Aging Brain Clinic for evaluation, diagnosis and treatment of complex, age-related conditions and diseases, including adult-onset hydrocephalus.

Neurology
Department Overview

Kerry Levin, M.D., Chairman

- Ranked fifth in the country and the best in Ohio by *U.S.News & World Report*.
- Provides leading-edge diagnosis and treatment for general adult neurological problems.
- Integrates resident training, academic endeavors and basic and clinical research.
- Performing Artists Program provides diagnosis and treatment for performance related neurologic disorders such as tremor, tic and dystonia.

Psychiatry and Psychology
Department Overview

George E. Tesar, M.D., Chairman

- Provides comprehensive adult, child and adolescent mental health and chemical dependency services.
- Inpatient, partial hospitalization, intensive outpatient, routine outpatient and emergency services available on separate child and adult units.
- Services offered include psychiatric, behavioral and psychosocial evaluation; brief psychotherapy (individual, couples, groups) and medication management for:
    - anxiety disorders (*e.g.*, agoraphobia, panic disorder, generalized anxiety disorder, social anxiety disorder)
    - attention deficit-hyperactivity disorder in children and adolescents
    - autism and related disorders (*e.g.* Asperger's) in children and adolescents
    - mood disorders (*e.g.*, depression and bipolar disorder)
    - obsessive-compulsive disorder
    - personality disorders
    - post-traumatic stress disorder
    - schizophrenia and other psychoses
    - somatoform disorders
    - treatment-resistant psychiatric disorders
    - women's mental health services related to pregnancy, the postpartum period and perimenopause

- Psychiatric occupational therapy is available to assist patients with independent living skills and role performance areas affected by mental illness.
- Neuromodulation Center provides inpatient care for moderate, severe or psychotic depression, obsessive-compulsive disorder and bipolar depression. Therapies available include vagus nerve stimulation, deep brain stimulation and transcranial magnetic stimulation.
- Chronic Pain Rehabilitation Program offers psychiatric, behavioral and psychosocial evaluation and multidisciplinary treatment for chronic pain.

Adult Psychiatry

Diagnoses: 67% of adult hospitalizations in 2006 were for psychoses; 11% for alcohol and/or drug abuse; 4% for personality disorders, 2% for depression and 16% for other diagnoses.

The top three diagnoses among the adult outpatient population for 2006 were episodic mood disorder (61%), anxiety, dissociative or somatoform disorders (16%) and other diagnoses (16%).

Demographics: Nearly three-fourths of adult inpatients in 2006 were from Cuyahoga County, and more than 50% of patients were between the ages of 35 and 54.

Length of Stay: Average length of stay continues to decline, reaching 4.2 in 2006, down from a peak of nearly 6 days in 2003.

Child and Adolescent Psychiatry

Diagnoses: Psychoses accounted for nearly 40% of pediatric hospitalizations in 2006; 13% were for personality disorders; 8% were for depression; 6% were for anxiety disorders and 39% were for DSM-IV "childhood mental disorders," including disruptive behavior disorders, pervasive developmental disorders, eating disorders and tic disorders.

The top three diagnoses in 2006 among the pediatric outpatient population were Attention Deficit-Hyperactivity Disorder (39%), mood disorders (21%) and anxiety, dissociative or somatoform disorders (18%).

Demographics: As on the adult inpatient unit, three-fourths of pediatric patients in 2006 were from Cuyahoga County. More than half of pediatric inpatients in 2006 were between the ages of 11 and 15; 30% were between 16 and 20; 16% were under age 10.

Length of stay: Average length of stay has remained constant since 2005 at approximately 3.8 days.

Chronic Pain Rehabilitation Program

Services: Provides inpatient, outpatient and emergency psychiatric, behavioral and psychosocial evaluation and multidisciplinary treatment for chronic pain.

Psychosomatic Medicine (formerly Consultation-Liaison)

Services: Provides psychiatric consultation and support to patients and their caregivers on the Cleveland Clinic main campus medical and surgical inpatient units.

Volume: Performed 1,625 new consultations and 1,716 follow-up visits for a total of 3,341 total consultation visits, a 5% increase compared to 2005.

The most frequent diagnoses made include post-operative delirium, adjustment disorder, major depressive episode, and somatoform disorder.

Serves as an important training experience for psychiatry and non-psychiatry residents and Cleveland Clinic Lerner College of Medicine of Case Western Reserve University Medical School students.

General and Health Psychology

Services: Specialists provide behavioral and psychosocial evaluation and cognitive-behavioral psychotherapy outpatient consultation to medical and surgical patients with stress-related disorders (*e.g.* headache, psychological testing, biofeedback and smoking cessation).

Diagnoses: The top three outpatient diagnoses in 2006 were episodic mood disorders (26%), anxiety, dissociative or somatoform disorders (19%) and adjustment reaction (14%).

Neuropsychology

Services: Provides neuropsychological testing for patients of all ages with cognitive disturbance related to epilepsy, movement disorder, dementia, hydrocephalus, head injury or cardiothoracic surgery.

Diagnoses: Most common diagnoses for adult neuropsychologic testing in 2006 were nervous system disorders (42%), epilepsy (27%), and Parkinson's disease (12%).

Alcohol and Drug Recovery Center

Services: Offers inpatient, partial hospitalization, intensive outpatient, routine outpatient and emergency services for patients age 12 and older with dependency and/or addiction to one or more licit or illicit substances.

Services available include comprehensive chemical dependency evaluation and counseling in group formats and inpatient detoxification from alcohol, sedatives, hypnotics or opiates featuring a 12-step approach.

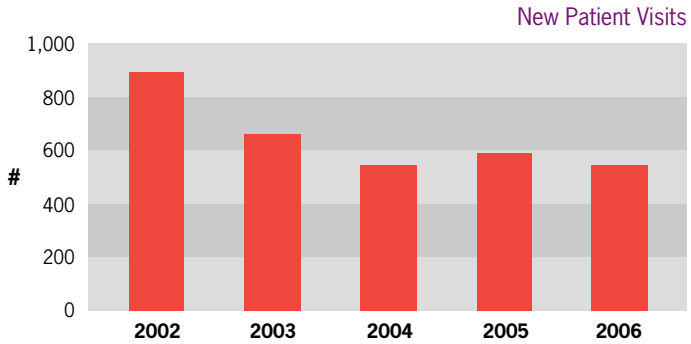
Diagnoses: Among drug and alcohol recovery outpatients, 41% had adjustment reaction; 25% were alcohol dependent; 18% were drug dependent; and 16% had other diagnoses.

Demographics: 38% of patients treated for alcohol or drug addiction in 2006 had other complicating factors.

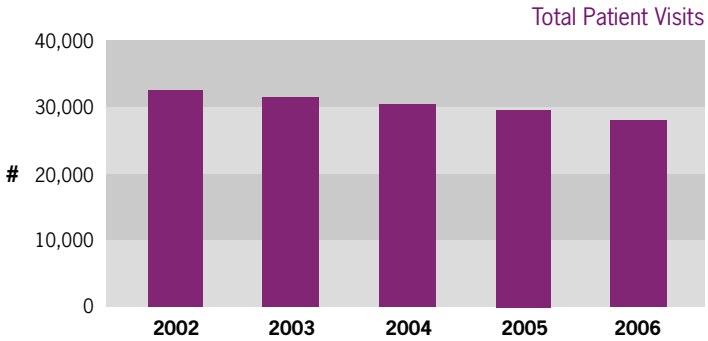
More than half of alcohol and drug recovery patients in 2006 came from Cuyahoga County. More than half were ages 35 to 54; 15% were ages 55 to 64; 15% were ages 25 to 34; 2% were under age 20.

Length of stay: Average length of stay for alcohol or drug recovery patients declined in 2006 to 4.5 days.

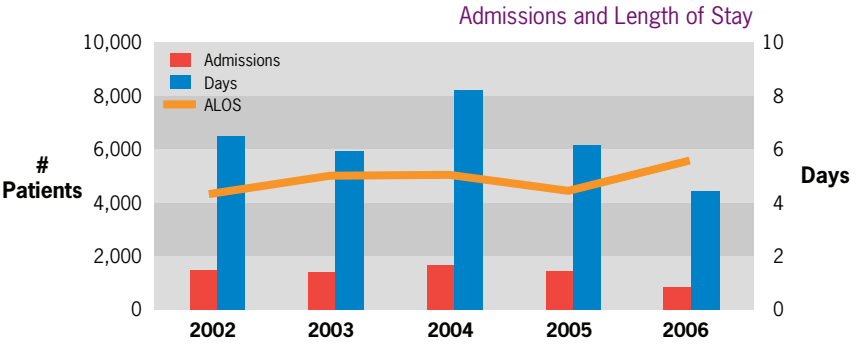
Psychiatry and Psychology |
Quality & Outcome Measures



The annual volume of new outpatient visits has remained between 500 and 600 visits since 2004.



The volume of total outpatient visits, declining since 2002, continued this trend in 2006 to just under 28,000 total visits.

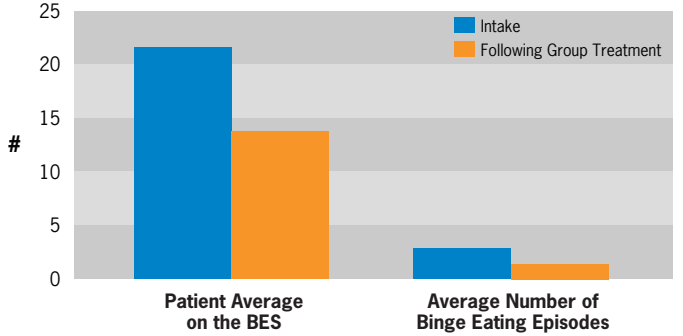


The number of patients admitted for psychiatric disorders declined in 2006 to about 1,000, while average length of stay increased from 4.4 days in 2005 to 5.6 days in 2006. These changes reflect the increased case complexity for inpatient psychiatric care.

Some of the Department's important outpatient outcomes include results from three specialized programs.

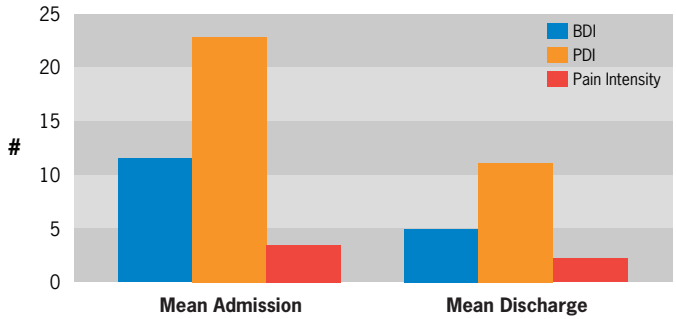
Binge Eating Group

Collaborating with the Cleveland Clinic Bariatric Metabolic Institute



The Binge Eating Group is a cognitive behavioral group therapy conducted by the Section of Psychosomatic Medicine designed for bariatric surgery patients who report behaviors consistent with Binge Eating Disorder (BED). Patients are given the Binge Eating Survey at the beginning and end of the four-week group to assess treatment progress.

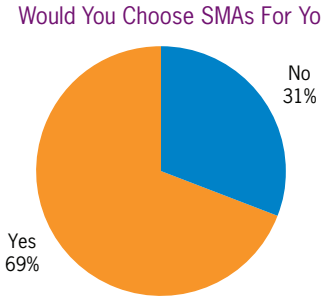
Chronic Pain Rehabilitation Program



In 2006, 212 patients were admitted to the Chronic Pain Rehabilitation Program. These patients typically had failed surgical, medical and interventional (regional anesthesia) treatment, were seriously disabled and had marked psychiatric comorbidity.

Pain, depression and disability were assessed at admission and at discharge.

Shared Medical Appointments for Patients with Depression

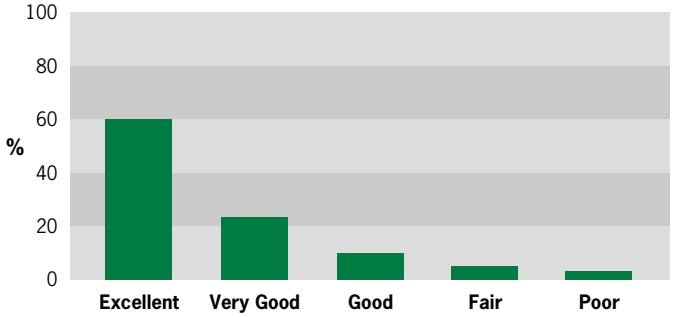


In 2003, the Department of Psychiatry and Psychology implemented 90-minute group visits (shared medical appointments) for medication management for women with depression. A patient satisfaction survey recently was mailed to 174 patients. A total of 77% of participants rated the experience good to excellent; 69% scheduled their follow up visits in the group setting, and 87% said they would recommend the group to other patients.

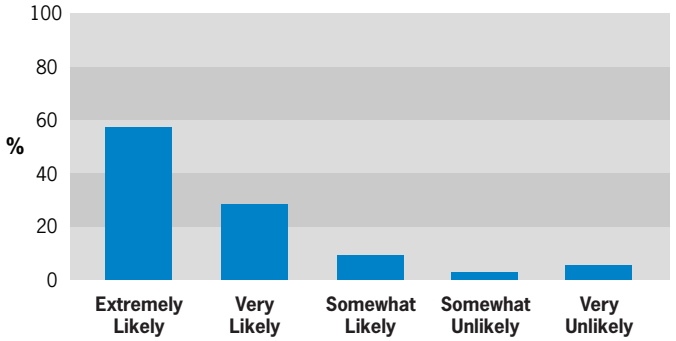
Psychiatry and Psychology
Patient Experience

We ask our patients about their experiences and satisfaction with the services provided by our staff. Although our patients are already indicating we provide excellent care, we are committed to continuous improvement.

Outpatient
Overall Rating of Care



Outpatient
Would Recommend Provider



Psychiatry and Psychology |
Innovations

- Establishment of the Psychiatric Neuromodulation Center, a collaboration between the Department of Psychiatry and the Center for Neurological Restoration, offering traditional (*e.g.* ECT) and novel treatments (*e.g.* deep brain stimulation and vagal nerve stimulation) to patients with psychiatric disorders refractory to common treatment modalities.
- Study of neuropsychological sequelae and predictors of outcome in epilepsy and other neurological disorders.
- Heart-Brain Institute collaboration to study the impact of depression and biofeedback on cardiovascular disorders.
- Study of brain circuitry involved in the generation and propagation of ECT-induced seizures.
- Establishment of interdisciplinary clinical collaborations among the Center for Child and Adolescent Psychiatry and the Department of Pediatric Hematology/ Oncology Palliative Medicine Program; Epilepsy Center; Section of Pediatric Nephrology; and the Cleveland Clinic Children's Hospital for Rehabilitation Center for Autism and Pediatric Pain Rehabilitation Program.
- Collaboration with University of Cincinnati on investigation of brain circuitry involved in bipolar disorder, specifically depression, utilizing functional magnetic resonance imaging (fMRI).

Psychiatry and Psychology |
New Knowledge

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Tesar, GE. A mosaic of misapplied minimalism. Response to Surgery of the Mind and Mood: A Mosaic of Issues in Time and Evolution. *Neurosurgery* 2006;59:738-739.

Psychiatry and Psychology | Chairman
Staff Listing

George Tesar, M.D.
Chairman, Department of Psychiatry and Psychology

Staff Listing

General Adult Psychiatry
Roman Dale, M.D.
Kathleen Franco, M.D.
Lilian Gonsalves, M.D.
Karen Jacobs, D.O.
Donald Malone, M.D.
David Muzina, M.D.
George Tesar, M.D.
Adele Viguera, M.D.

Child and Adolescent Psychiatry
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John Glazer, M.D.
Kathleen Quinn, M.D.
Barry Simon, D.O.

Chronic Pain Rehabilitation Program
Edward Covington, M.D.
Judith Scheman, Ph.D.

Psychosomatic Medicine
Kathy Lee Coffman, M.D.
Lilian Gonsalves, M.D.
Leopoldo Pozuelo, M.D.
Isabel Schuermeyer, M.D.
George Tesar, M.D.

General and Health Psychology
Kathleen Ashton, Ph.D.
Scott Bea, Psy.D.
Dana Brendza, Psy.D.
Karen Broer, Ph.D.
Steven Krause, Ph.D.
Michael McKee, Ph.D.
Scott Meit, Psy.D.
Amy Windover, Ph.D.

Neuropsychology
Robyn Busch, Ph.D.
Jennifer Haut, Ph.D.
Patricia Klaas, Ph.D.
Cynthia Kubu, Ph.D.
Richard Naugle, Ph.D.

Alcohol and Drug Recovery Center
Gregory Collins, M.D.
Joseph Janesz, Ph.D., Lic. D.C.
David Streem, M.D.

Neurological Institute Regional Centers | Overview

The Cleveland Clinic Neurological Institute is an enterprise-wide endeavor to provide world-class diagnosis and treatment to patients across Northeast Ohio. Through the Regional Centers, the Neurological Institute provides world-class neurological care at six major facilities in the Cleveland Clinic Health System: Fairview, Lakewood and Lutheran hospitals on Cleveland's west side and Euclid, Hillcrest and Huron hospitals on the east side.

Staff Listing

Romeo Craciun, M.D.
Michael Mervart, M.D.
Samuel Tobias, M.D.
Samuel Borsellino, M.D.

Brain Tumor and Neuro-Oncology Center

Director's Letter

Established in 2001, the Cleveland Clinic Brain Tumor and Neuro-Oncology Center (formerly Brain Tumor Institute) is among the leading programs in the United States for the diagnosis and treatment of primary and metastatic tumors of the brain, spine, nerves and their effects on the nervous system. Now, part of the newly established Cleveland Clinic Neurological Institute, the Brain Tumor and Neuro-Oncology Center continues to collaborate with the Taussig Cancer Center to provide innovative solutions for these complex problems utilizing the latest technologies.

The success of the Brain Tumor and Neuro-Oncology Center was evident in 2006 with more patients than ever being served and more than a quarter of new patients coming from outside Ohio borders. We expanded our services, improved patient satisfaction, attracted world-class physicians and scientists to our staff, made significant advances in basic and clinical research and offered a broad array of educational experiences, including international forums.

We believe outcomes reporting serves a need for referring physicians, patients, alumni and donors in making various decisions. Equally important, we believe outcomes reporting encourages our clinicians to set the bar higher in their daily practices.

We are pleased to present our outcomes data for 2006 and hope you find it useful and informative.

Gene H. Barnett, M.D.
Director, Brain Tumor and Neuro-Oncology Center

Brain Tumor and Neuro-Oncology Center

Center Overview

- Annually treats more than 3,000 patients with brain tumors and other related conditions; more than 25% of patients come from outside Ohio.
- Offers state-of-the-art diagnostic and treatment modalities, including intraoperative MRI, stereotactic neurosurgery, Gamma Knife radiosurgery, Novalis shaped-beam surgery, convection-enhanced delivery and blood-brain barrier disruption.
- Surgeons performed more than 900 procedures for brain tumors in 2006 including stereotactic radiosurgery (Gamma Knife) and surgery.
- The Gamma Knife Center, under the leadership of Drs. John Suh and Gene Barnett, treated the Center's 2,000th case in 2006.
- Supratentorial craniotomy (n=299) and Gamma Knife radiosurgery (n=288) accounted for approximately 64% of all surgical procedures in 2006.
- Gliomas (n=826), metastases (n=404) and meningiomas (n=352) accounted collectively for 82% of all cases in 2006.
- Case complexity increased over the past five years while average length of stay remained fewer than five days.
- Availability of numerous clinical trials bring novel therapeutic agents from the laboratory to the patient as rapidly as possible; more than 400 patients were enrolled in clinical trials in 2006.

Cooperative Groups

Blood-Brain Barrier Disruption (BBBD) Consortium
New Approaches to Brain Tumor Therapy (NABTT) Consortium
American College of Surgeons Oncology Group (ACoSOG)
Radiation Therapy Oncology Group (RTOG)
Southwest Oncology Group (SWOG)

Funding:

- Basic Research
  - Two federal awards totaling $2,862,664
  - Seven foundation awards totaling $466,028
  - One corporate-funded project totaling $43,212
- Clinical Research
  - Two NIH-funded projects totaling $261,722
  - One foundation award totaling $10,000
  - Five projects funded via federal subcontracts totaling $128,901

2006 Brain Tumor and Neuro-Oncology Center Courses

Professional Education

Course name	Dates	Location	Number of Participants
Gamma Knife Training Course for Cleveland Clinic Professionals	January 12-13	Cleveland Clinic	9
Convection-Enhanced Delivery to the Brain Symposium	February 11-12	Cleveland Clinic	50
Gamma Knife Winter Course	February 20-24	Cleveland Clinic	10
Contemporary Issues in Pituitary Disease: Case Management Update	March 10	Cleveland Clinic	45
Gamma Knife Spring Course	April 3-7	Cleveland Clinic	10
Brain Tumor Summit	May 19-20	Cleveland Clinic	50
Neuro-Oncology: Current Concepts	May 26-28	Hamburg, Germany	75
Gamma Knife Summer Course	August 21-25	Cleveland Clinic	10
Blood-Brain Barrier Disruption Consortium Meeting	September 30	Cleveland Clinic	15
Gamma Knife Fall Course	October 23-27	Cleveland Clinic	10
Gamma Knife Winter Course	December 4-8	Cleveland Clinic	10

Patient Education

Course Name	Dates	Location	Number of Participants
Pituitary Management Patient Program	March 9	Cleveland Clinic	110
Brain Tumors: Confronting the Challenge Together! Collaboration with The Brain Tumor Society	September 9	Cleveland Clinic	110

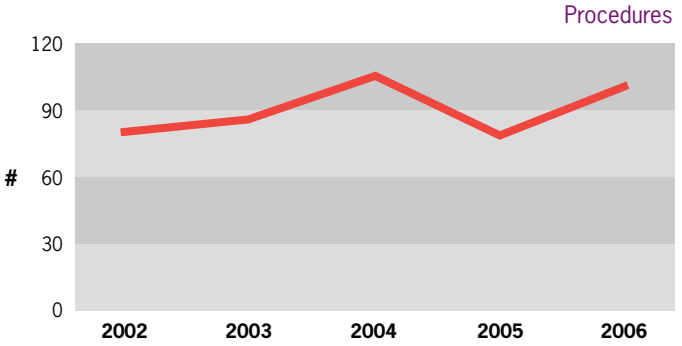
2006 Professional Education Highlights

As part of its mission to advance brain tumor treatment and research through collaboration and education, the Cleveland Clinic Brain Tumor and Neuro-Oncology Center (BTNC) hosted the third international summit on finding the cure for glioblastoma. This successful event brought together 50 invited guests to discuss cutting-edge research and the latest in treatment options for glioblastoma. The event featured several guest speakers as well as Cleveland Clinic staff.

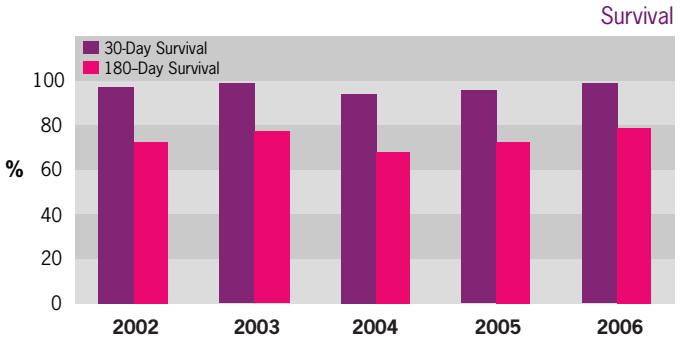
Also in May, the BTNC and University Hospital Hamburg-Eppendorf co-sponsored the international symposium "Neuro-Oncology 2006: Current Concepts" in Hamburg, Germany. The location of this well-established transatlantic collaboration alternates between the United States and Europe. More than 75 participants from around the world gathered to discuss research, current strategies of treatment and innovative clinical trials affecting the area of neuro-oncology. Active and recently completed clinical trials in the United States (RTOG) and Europe (EORTC) for glioma clinical trials were discussed. The symposium also focused on brain metastases, a life-threatening condition that affects nearly one-quarter of cancer patients.

Brain Tumor and Neuro-Oncology Center
Quality & Outcome Measures

Brain Biopsy

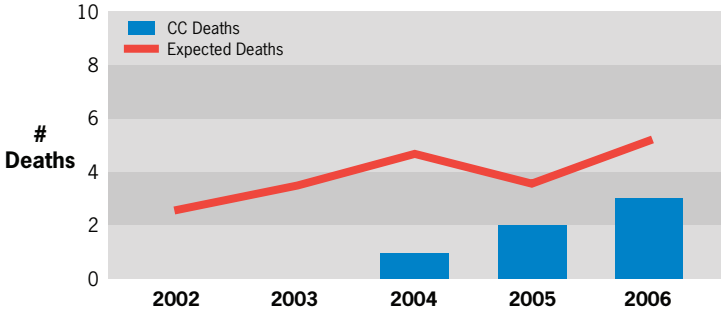


Procedure volume increased by nearly 30% over 2005 to 101 while 30- and 180-day survival rates for brain biopsies reached 98% and 78.2%, respectively. This represents a 4% increase in 30-day survival over 2005 and a nearly 7% increase in 180-day survival.



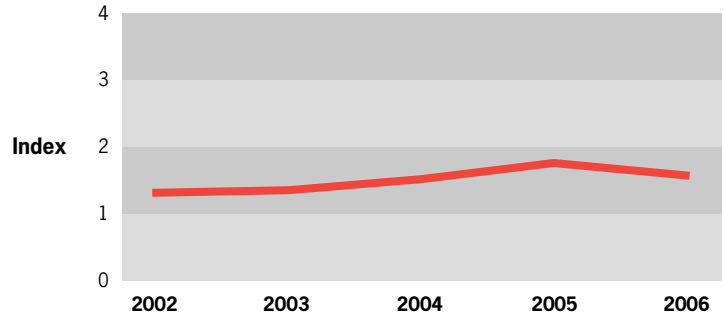
Thirty- and 180-day survival rates for brain biopsies reached 98% and 78.2%, respectively. This represents a 4% increase in 30-day survival over 2005 and nearly a 7% increase in 180-day survival, while procedure volume increased by nearly 30% over 2005 to 101.

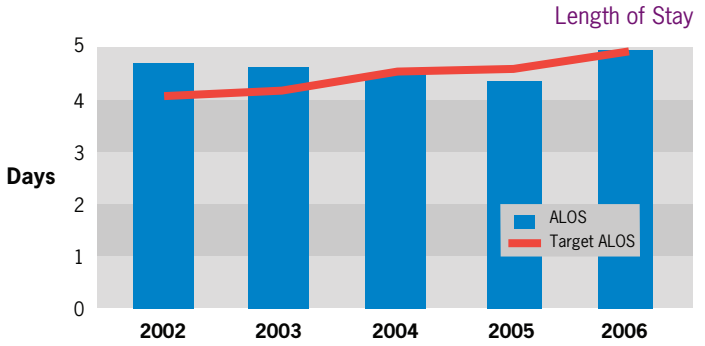
Mortality



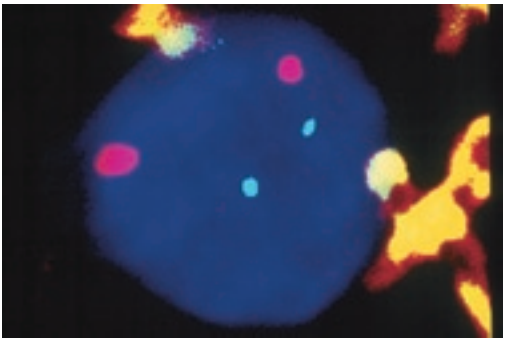
Mortality rate remained below the expected rate in each of the last five years, despite a continuing high severity of illness index.

Severity of Illness



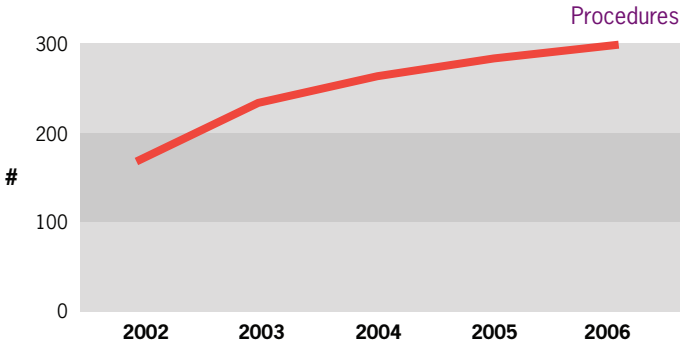


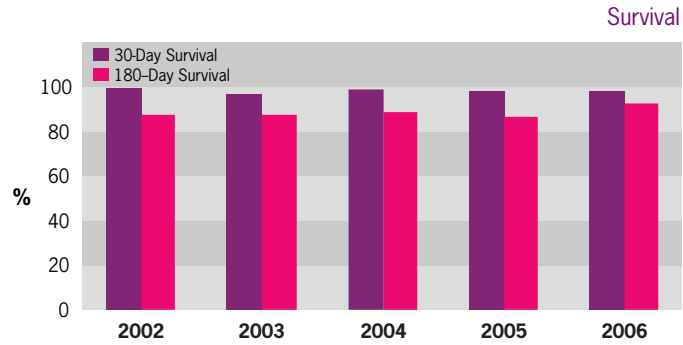
Average length of stay has remained at approximately five days since 2002.



FISH assay of oligodendroglioma with chromosomes 1p and 19q intact

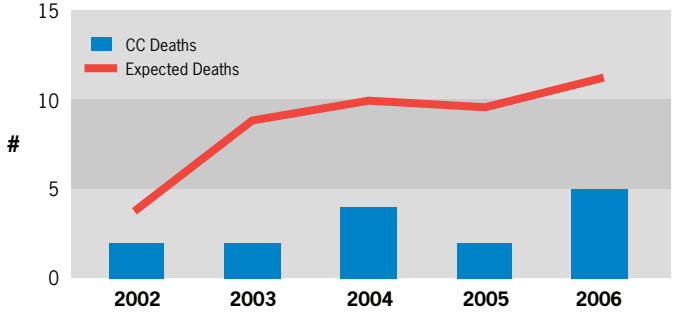
Supratentorial Craniotomy





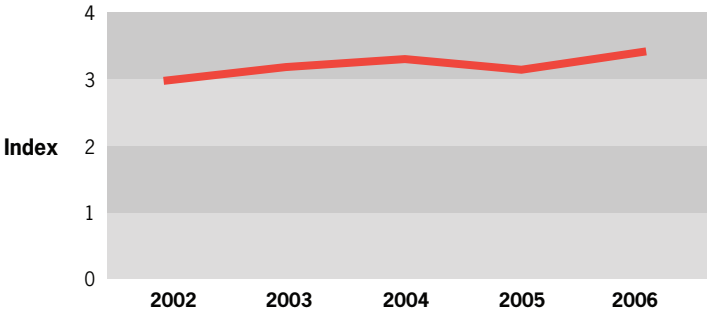
Despite a nearly 80% increase in surgical volume since 2002 as well as an increase in case complexity, 30- and 180-day survival rates remained at 98% and 93%, respectively in 2006.

Mortality

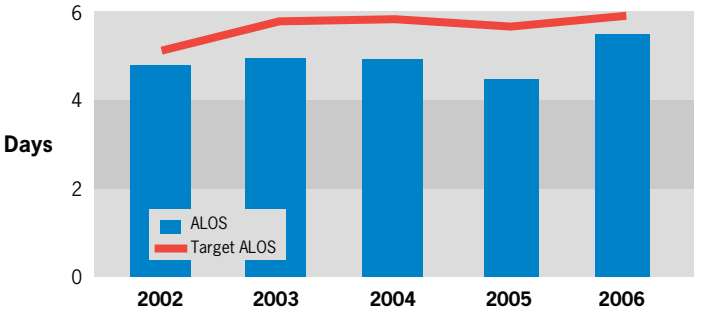


Overall mortality remained significantly lower than predicted in 2006, continuing the trend over the past four years.

Severity of Illness

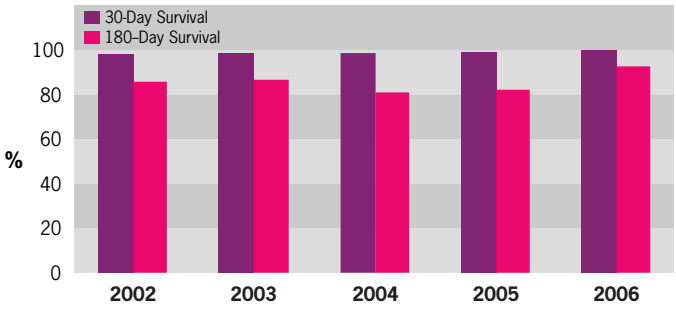


Length of Stay

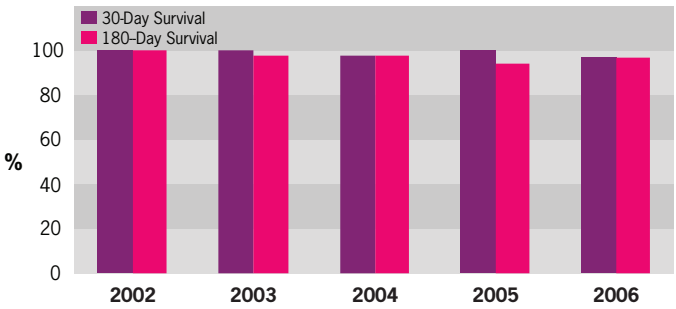


Average length of stay rose slightly in 2006 to just over five days with the median length of stay remaining at three days.

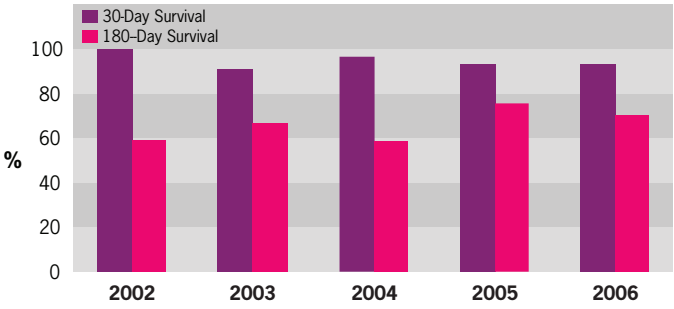
Gliomas



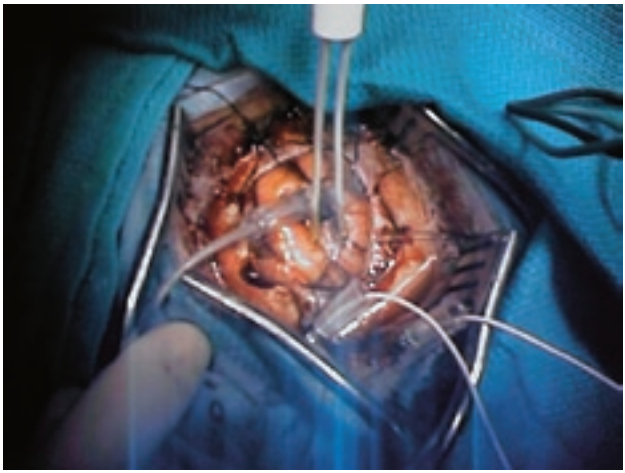
Meningiomas



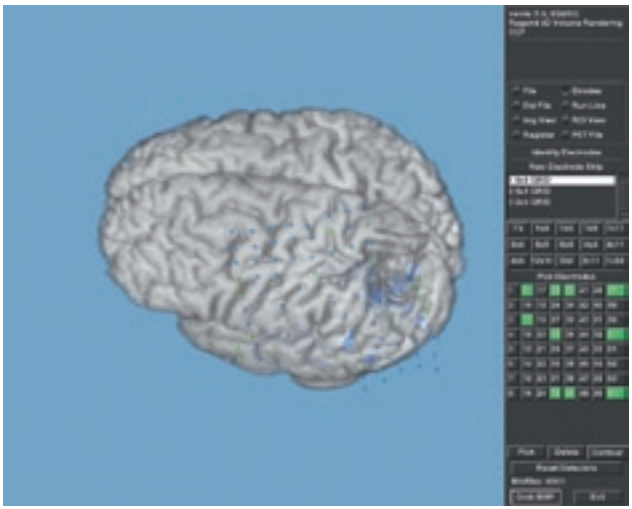
Metastases



MRI fiber tracking of corticospinal tracts showing cut-off of right-side fibers



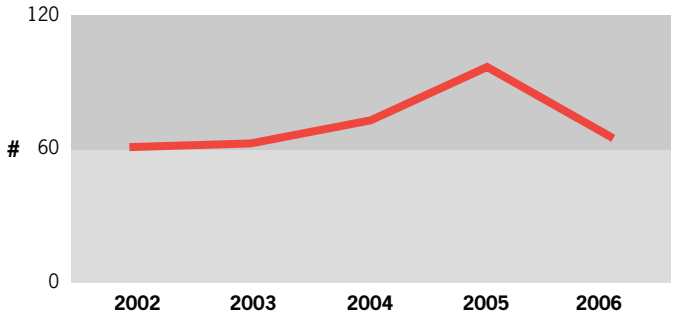
Intraoperative cortical stimulation testing for neurological function



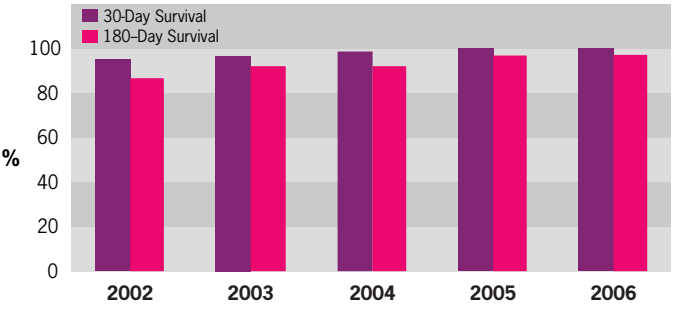
Computer-generated map of electrode grid used for brain cortex stimulation and recording

Infratentorial Craniotomy

Procedures



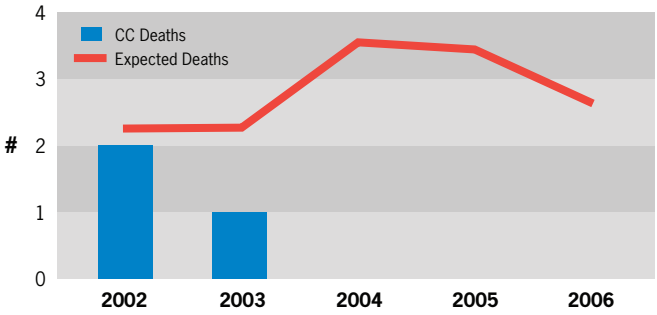
Survival



We have performed more than 360 infratentorial craniotomies over the past five years.

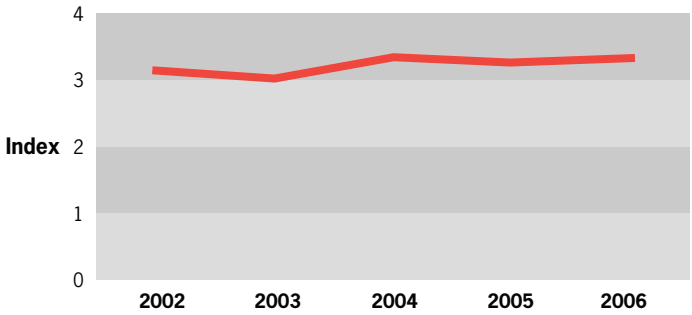
Thirty- and 180-day survival rates are consistently high, 100% and 98%, respectively in 2006.

Mortality

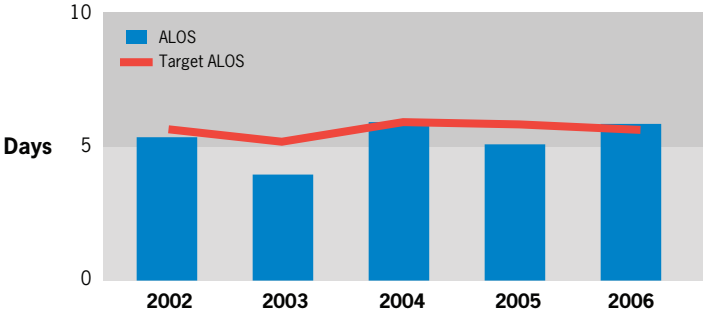


In 2006, mortality remained significantly lower than predicted with no reported surgical mortalities, while case severity index remained high.

Severity of Illness

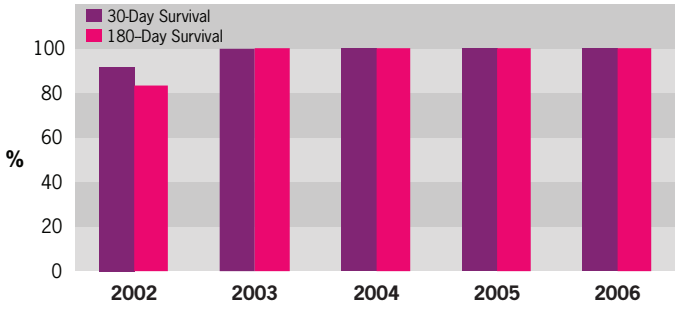


Length of Stay

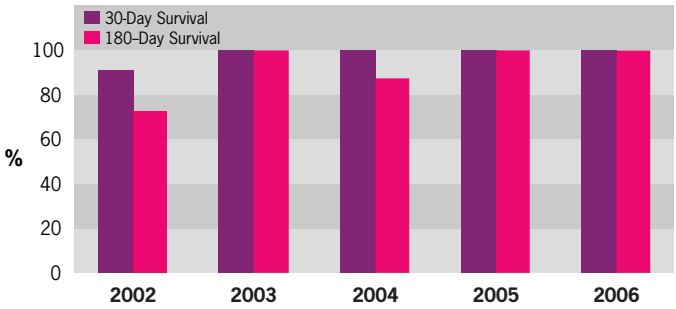


Average length of stay in 2006 was consistent with previous years at 5.86 days.

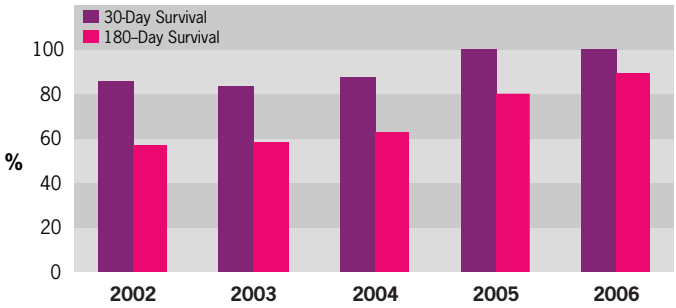
Gliomas

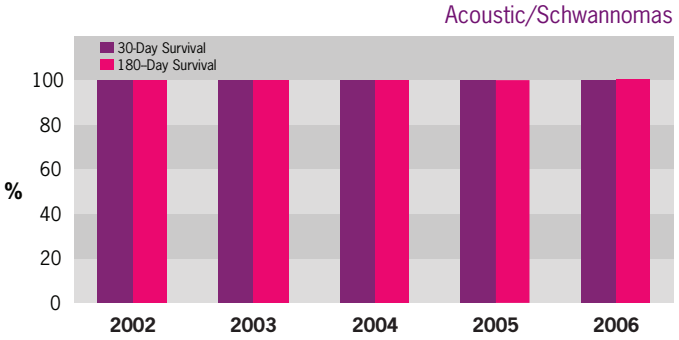


Meningiomas

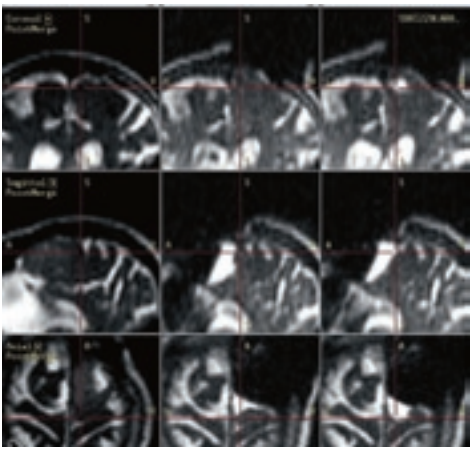


Metastases





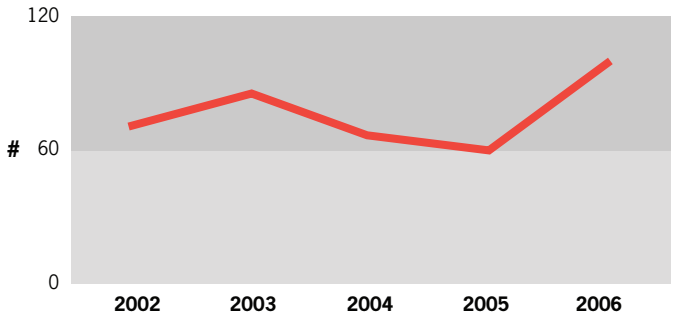
Thirty-day survival for post-infratentorial craniotomy of gliomas, meningiomas, metastases and schwannomas remained perfect at 100% in 2006. The 180-day survival rate also was 100% for gliomas, meningiomas and schwannomas and increased to 89% for metastases.



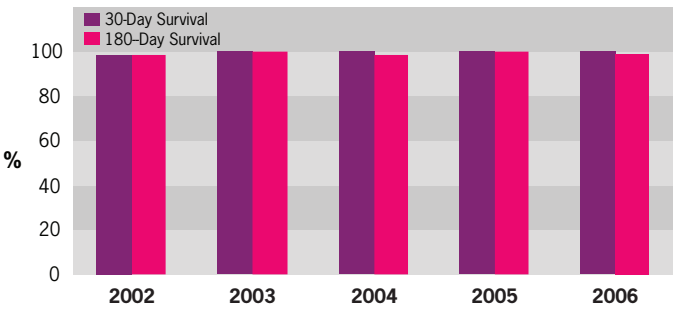
iMRI unit and sequence showing incremental tumor resection

Pituitary

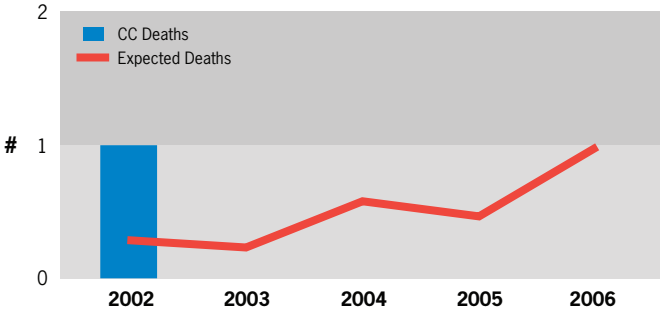
Procedures



Survival

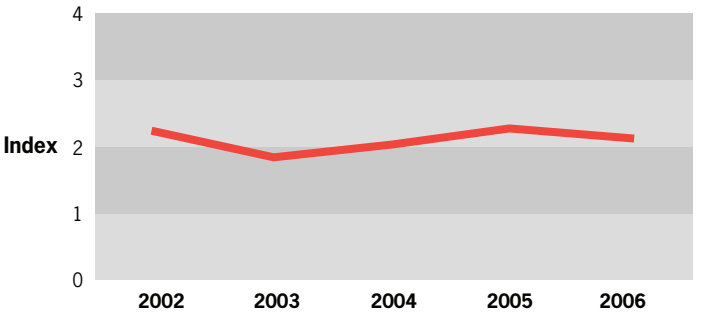


Mortality

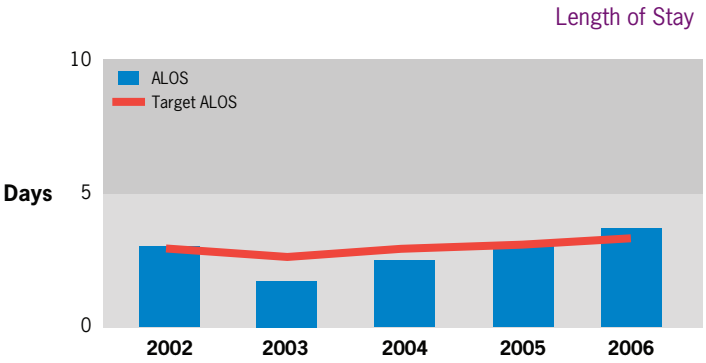


In 2006, 30- and 180-day survival rates were 100% and 99%, respectively. Despite a more than 50% increase in volume of cases in 2006 over 2005, surgical mortality remained at 0, continuing the trend of the past three years.

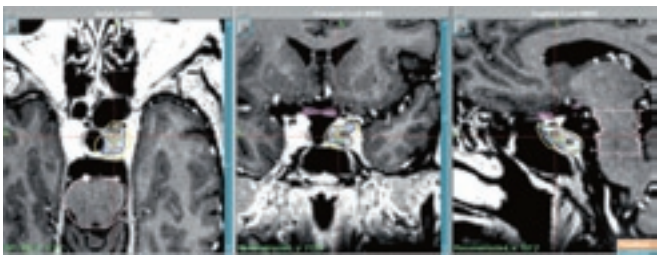
Severity of Illness



The case severity index remained steady at approximately 2.2.



Average length of stay has trended upwards in the past four years, reaching 3.73 days in 2006 with a median length of stay of two days.

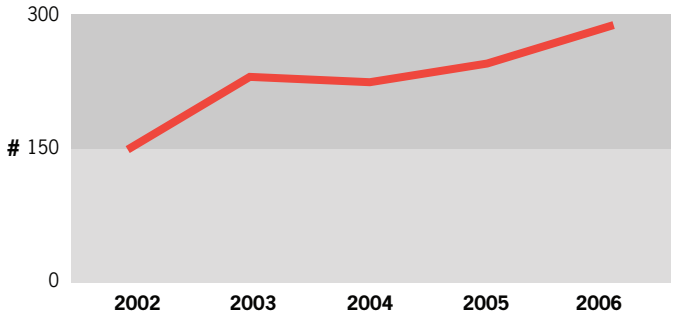


Gamma Knife radiosurgery of residual hormonally-active adenoma. (From left to right) Axial, coronal, and sagittal T1-weighted, post-contrast magnetic resonance images with the treatment plan for the residual tumor in the left cavernous sinus. The tumor is outlined in blue and the 50% isodose line in yellow. Care is taken to avoid the optic nerves and chiasm (purple) and brainstem (pink).

Stereotactic Radiosurgery

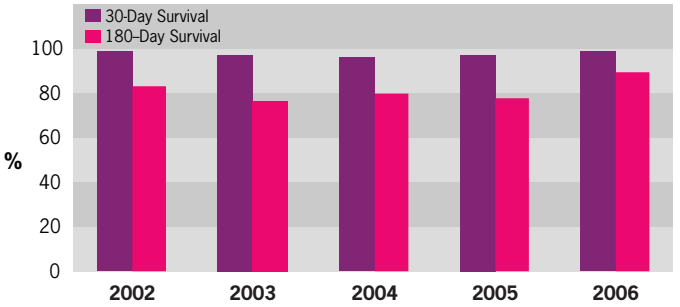
Gamma Knife

Procedures



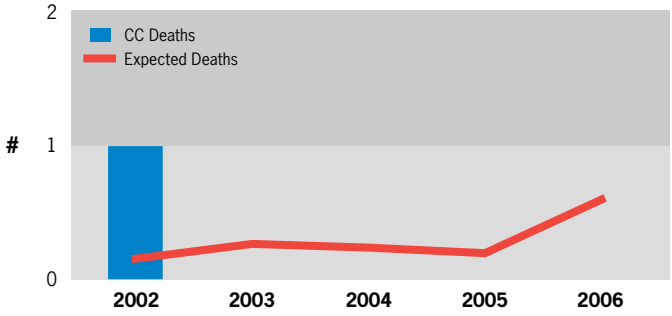
The number of Gamma Knife procedures continues to trend upwards, reaching nearly 300 in 2006. Gamma Knife radiosurgery is an outpatient procedure.

Survival



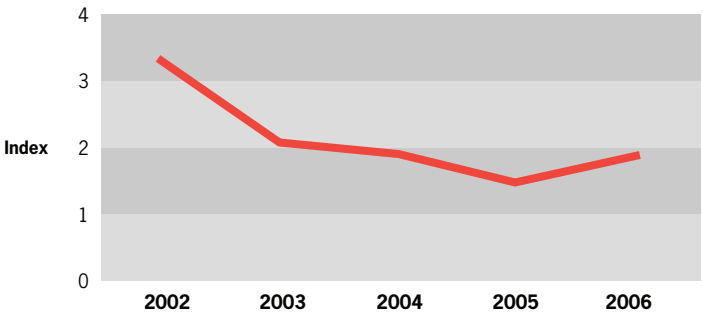
In 2006, 30- and 180-day survival rates were 99% and 89%, respectively. This represents a 12% increase in 180-day survival over 2005.

Mortality

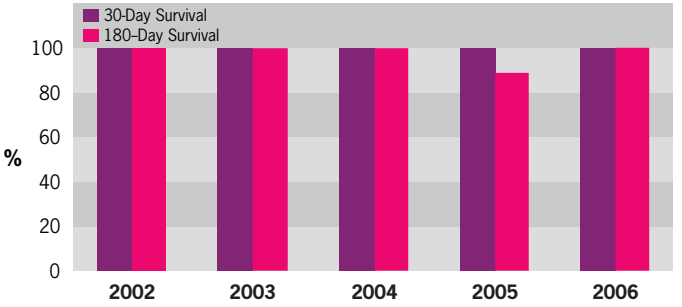


Gamma Knife continues to demonstrate an excellent record with only a single procedure-related death since 2002. During this period, the number of procedures increased from 154 to 288.

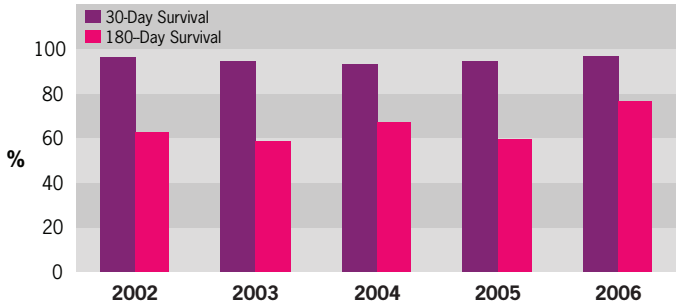
Severity of Illness



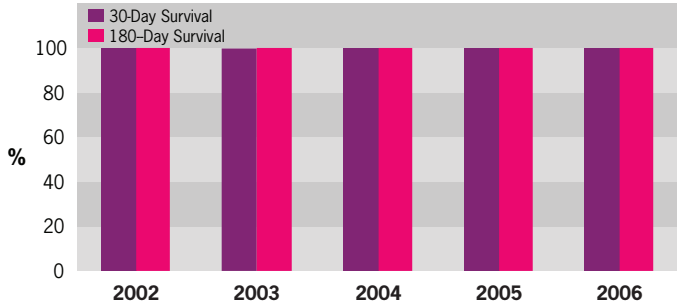
Meningiomas



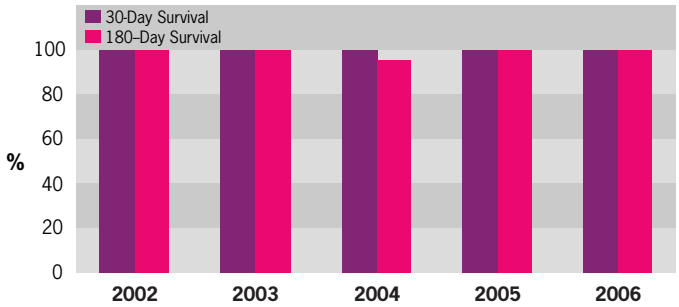
Metastases



Pituitary

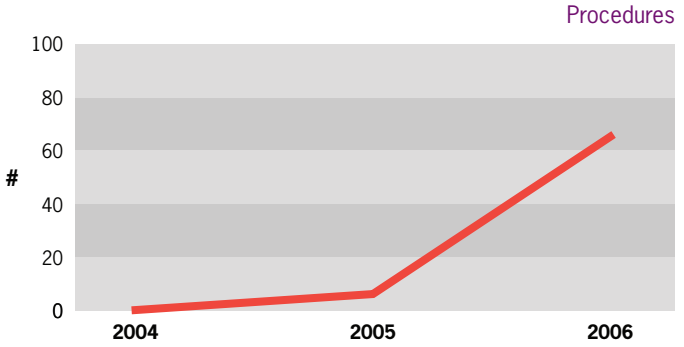


Acoustic/Schwannoma

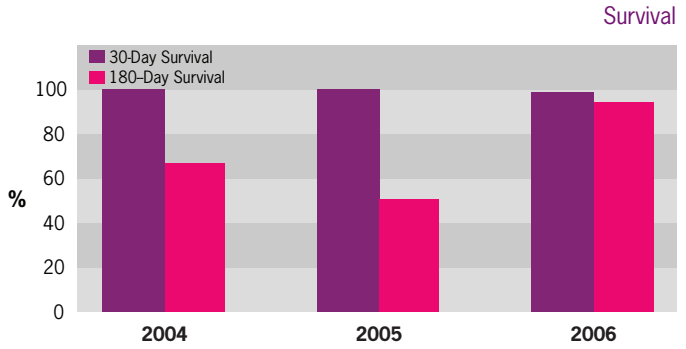


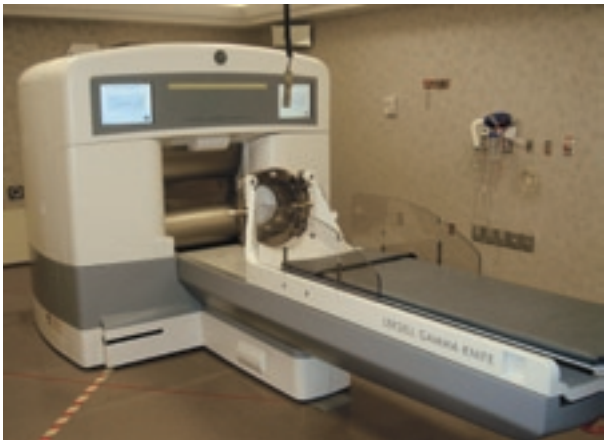
Thirty-day survival for meningiomas, pituitary tumors and schwannomas treated with Gamma Knife remained perfect at 100%. Both survival measures increased significantly for metastases, rising to 96.8%, 30-day and 76.6%, 180-day.

Novalis

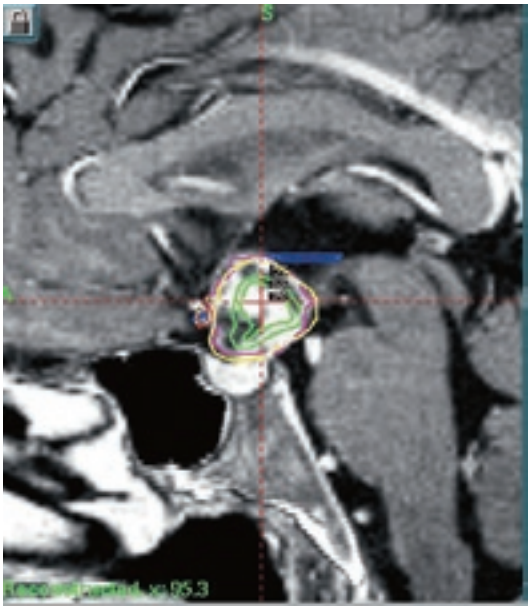


The volume of Novalis surgeries increased from six in 2005 to 65 in 2006. Thirty- and 180-day survival rates were excellent at 98% and 94%, respectively.





Gamma Knife Unit Model 4C

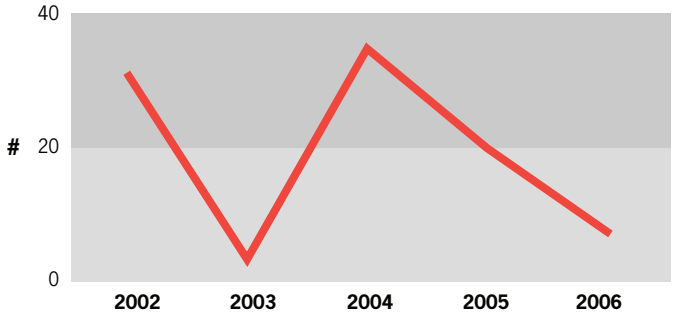


Gamma Knife plan for treatment of craniopharyngioma

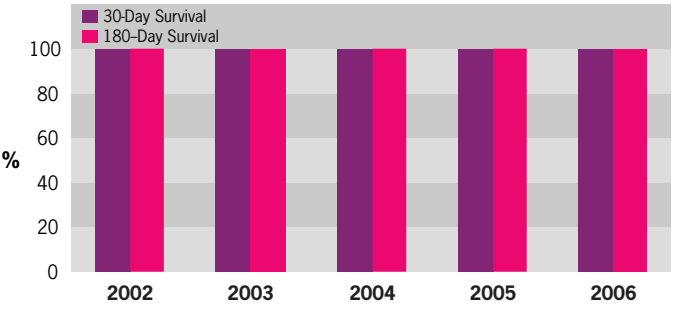
Blood-Brain Barrier Disruption (BBBD)

Interarterial Chemotherapy (IA)

Procedures

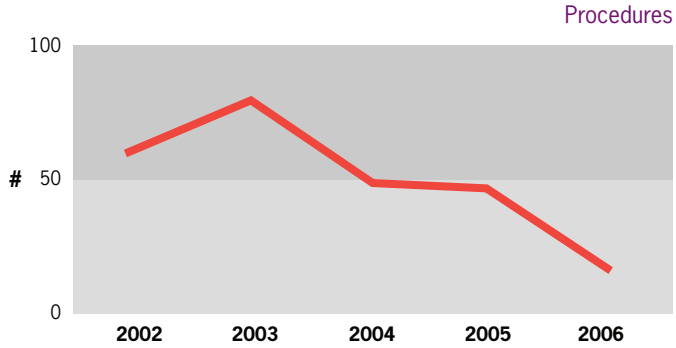


Survival

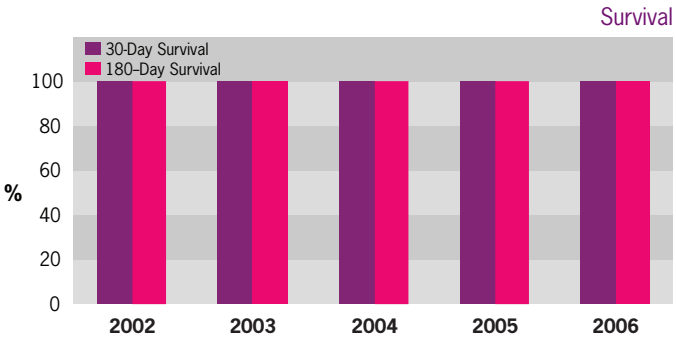


We have performed more than 90 interarterial chemotherapy procedures over the past five years. Thirty- and 180-day survival rates remained perfect in 2006 at 100%, continuing the trend of the past four years.

BBBD



We have performed more than 250 blood-brain barrier disruption procedures over the past five years. Thirty- and 180-day survival rates have been 100% since 2001.



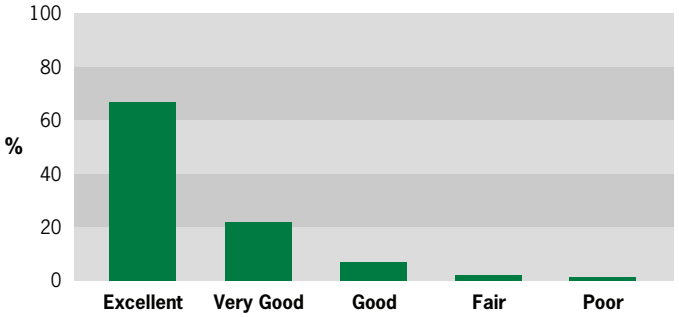
CT showing disruption in right internal carotid artery territory after BBBD

Brain Tumor and Neuro-Oncology Center

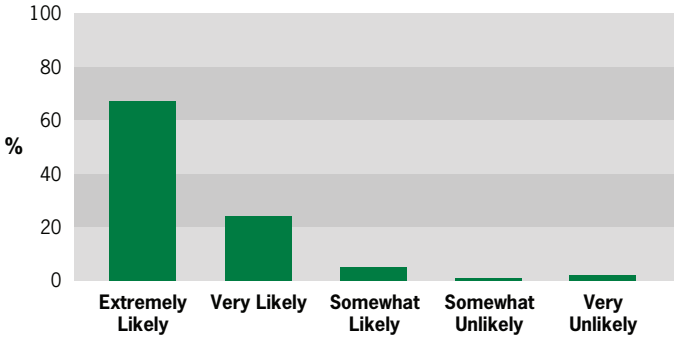
Patient Experience

We ask our patients about their experiences and satisfaction with the services provided by our staff. Although our patients are already indicating we provide excellent care, we are committed to continuous improvement.

Outpatient
Overall Rating of Care



Outpatient
Would Recommend Provider



Brain Tumor and Neuro-Oncology Center | Innovations

- Launched new spinal radiosurgery program with a dedicated spine tumor board.
- Developed the first program in Ohio for the treatment of spine tumors using high precision, noninvasive stereotactic radiosurgery (with Novalis shaped beam surgery).
- Designed tools to allow *in vivo* detection of optical nanoparticles that ultimately may improve biopsy and surgical accuracy.
- First to link aberrant activation of transcription factor NFκB to enhanced invasion by gliomas and define a likely autocrine mechanism for the effect of NFκB on invasion.
- Identified tumor-specific toxicity of modified double-stranded RNA constructs.
- Phase I clinical trial on the efficacy of temozolomide in patients with malignant gliomas in the presence or absence of the drug methoxyamine.
- Demonstrated the impact of aberrant overexpression of STAT3 in gliomas.
- Established protein profiling of brain tumors to determine how these tumors develop, progress and respond to therapy.
- Identified a new set of markers that may be useful in identifying which women with breast cancer are more likely to develop brain metastases.
- Developed a novel detection method for micro-RNA complexes in eukaryotic cells.

Brain Tumor and Neuro-Oncology Center | New Knowledge

Barnett GH (ed). High-Grade Gliomas: Diagnosis and Treatment, 2007:pp495 (27 chapters). Totowa, N.J.:Humana Press, Inc.

Barnett GH, Maciunas RJ, Roberts DW (eds). Computer-Assisted Neurosurgery, 2006:302. New York, N.Y.: Taylor & Francis Group.

Chao ST, Barnett GH, Liu S, Reuther AM, Toms SA, Vogelbaum MA, Videtic GJ, Suh JH. Five-year survivors of brain metastases: A single-institution report of 32 patients. *International Journal of Radiation Oncology, Biology, Physics* 2006;3:801-809.

Kanner AA, Staugaitus S, Castilla EA, Chernova O, Prayson RA, Vogelbaum MA, Stevens G, Peereboom D, Suh JH, Lee SY, Tubbs RR, Barnett GB. The impact of genotype on outcome in oligodendroglioma: validation of the loss of chromosome arm 1p as an important factor in clinical decision making. *J Neurosurg* 2006;104:542-550.

Lee JH, Sade B, Choi E, Golubic M, Prayson R. Midline Skull Base and Spinal Meningiomas are Predominantly of the Meningothelial Histological Subtype. *Journal of Neurosurgery* 2006;105(1):60-4.

McClelland S, Tendulkar RD, Barnett GH, Neyman G, Suh JH. Long-term Results of Radiosurgery for Refractory Cluster Headache. *Neurosurgery* 2006; 59(6):1258-1263.

Nathoo N, Ugokwe K, Chang A, Liang L, Ross J, Suh J, Vogelbaum M, Barnett G. The Role of 111 indium-octreotide brain scintigraphy in the diagnosis of cranial, dural-based meningiomas. *Journal of Neuro-Oncology* 2006; July 19 http://dx.doi.org/10.1007/s11060-006-9210-5.

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Vogelbaum MA, Angelov L, Lee S-Y, Li L, Barnett GH, Suh JH. Local control of Brain Metastases by Stereotactic Radiosurgery Depends Upon the Dose to the Tumor Margin. *Journal of Neurosurgery* 2006;104(6):907-912.

Brain Tumor and Neuro-Oncology Center | Director

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Associate Director, Gamma Knife Center
The Rose Ella Burkhardt Chair in Neurosurgical Oncology

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Heinrich Elinzano, M.D.
Glen Stevens, D.O., Ph.D.

Pediatric Hematology/Oncology
Tanya Tekautz, M.D.

Radiation Oncology
Samuel Chao, M.D.
John Suh, M.D.

Center for Neurological Restoration | Director's Letter

Cleveland Clinic's Center for Neurological Restoration (CNR) integrates a dedicated team of expert neurosurgeons, neurologists, neuropsychologists and neuroscientists. This cutting-edge interdisciplinary clinical and research team provides the latest diagnostic and therapeutic approaches for patients with various movement disorders, chronic pain, peripheral nerve, psychiatric conditions and brain injury disorders.

CNR specialists are world-leading experts for medical and surgical management of movement disorders such as Parkinson's disease, dystonia, essential tremor and spasticity. In the chronic pain arena, CNR works closely with neurology and pain management specialists in providing neurostimulation and neuromodulation therapies for treatment of severe intractable facial pain, headaches, reflex sympathetic dystrophy, stroke pain and other intractable central pain conditions. All surgical aspects of peripheral nerve disorders are also managed at the CNR.

Innovative deep brain stimulation (DBS) approaches for patients with intractable obsessive-compulsive disorder (OCD), Tourette syndrome and major depression are under investigation in collaboration with the Department of Psychiatry and Psychology. The CNR team is also pioneering approaches for treatments of traumatic brain injury and stroke.

We are committed to providing our patients with the highest quality care and we welcome the opportunity to work with you.

Ali R. Rezai, M.D.
Director, Center for Neurological Restoration

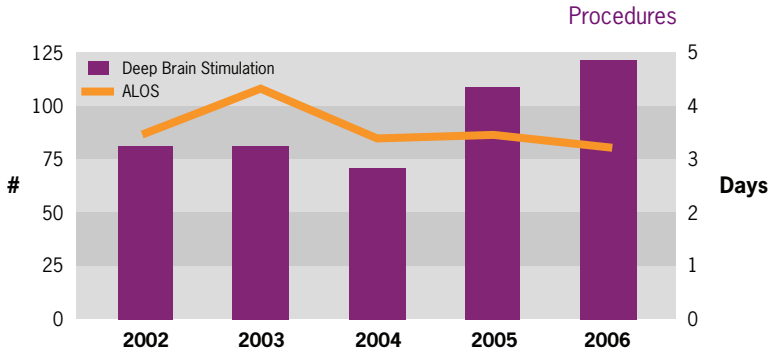
Center for Neurological Restoration |
Center Overview

- Multidisciplinary team of renowned neurosurgeons, neurologists, neuropsychologists, neuroscientists and healthcare specialists dedicated to providing cutting-edge diagnostic and therapeutic approaches for patients with intractable neurological disorders.
- Leader in medical and surgical management of movement disorders, including Parkinson's disease, essential tremor, dystonia and spasticity.
- Approximately 5,000 outpatient visits in 2006 for various movement disorders.
- National Parkinson's Foundation Center of Excellence.
- World leader in deep brain stimulation (DBS) surgery with more than 1,000 DBS implants performed.
- Surgical management of intractable chronic pain utilizing various nervous system lesionings, spinal cord stimulation, peripheral nerve stimulation, cranial nerve stimulation and deep brain stimulation.
- Surgical management of various peripheral nerve disorders.
- Clinical trials investigating the use of DBS for intractable obsessive-compulsive disorder, major depression, Tourette syndrome, traumatic brain injury and stroke.
- Active research program in intraoperative neurophysiology, functional brain imaging and neuromodulation and innovative neuromodulation therapeutic strategies.

Center for Neurological Restoration | Quality & Outcome Measures

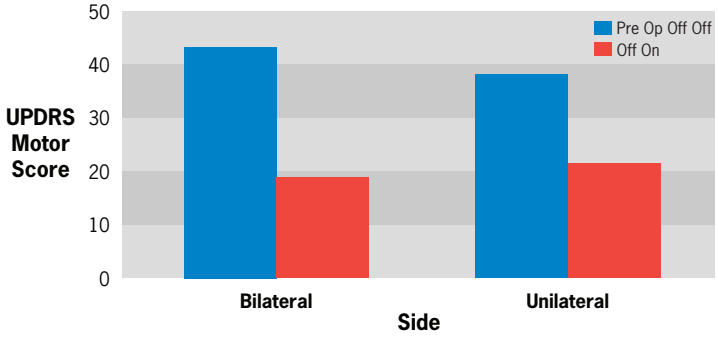
Deep Brain Stimulation (DBS)

Cleveland Clinic remains at the forefront of a specialty that has only begun to realize its treatment potentials. DBS is currently in the same developmental stage as heart pacemakers were 20 to 30 years ago. Cleveland Clinic is consistently one of the top performers in the United States for DBS implants for movement disorders and is rapidly expanding its applications to other types of disorders.

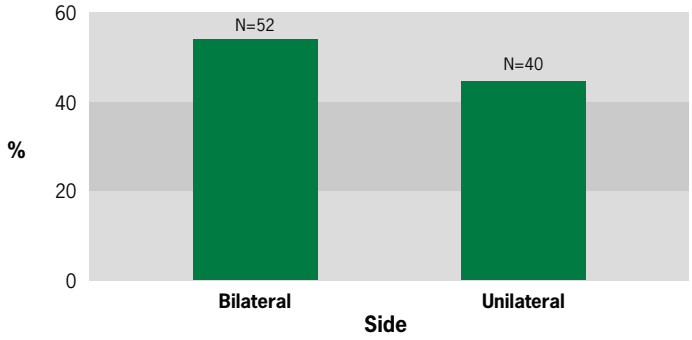


The procedure volume has increased significantly since 2002. Over this same period, average length of stay (ALOS) remains consistent at approximately three days.

Unified Parkinson's Disease Rating Scale
Motor Scores following DBS



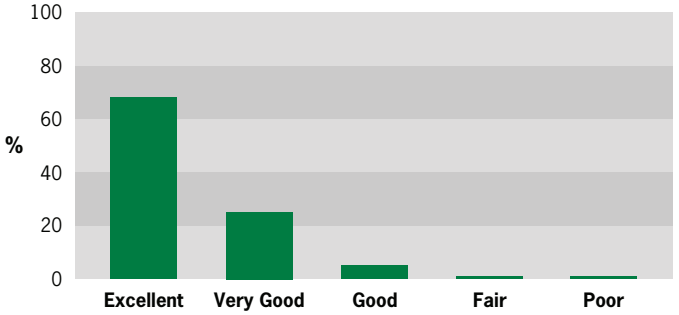
Improvement in Motor Score



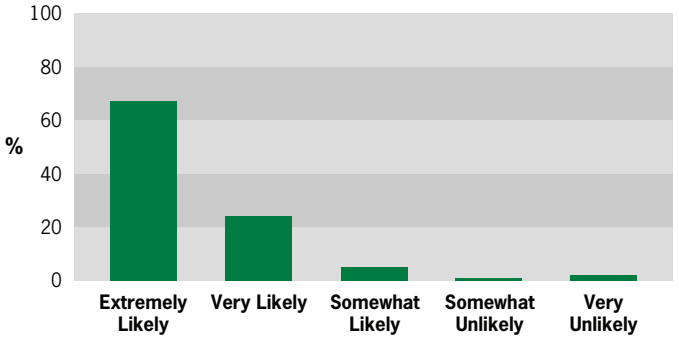
Center for Neurological Restoration | Patient Experience

We ask our patients about their experiences and satisfaction with the services provided by our staff. Although our patients are already indicating we provide excellent care, we are committed to continuous improvement.

Outpatient
Overall Rating of Care



Outpatient
Would Recommend Provider



Center for Neurological Restoration | Innovations

- Pioneering the use of DBS for treatment of intractable obsessive-compulsive disorders, depression, traumatic brain injury and stroke.
- Developing next generation DBS brain leads and pulse generators.

Center for Neurological Restoration | New Knowledge

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Center for Neurological Restoration | Director
Staff Listing

Ali Rezai, M.D.
Director, Center for Neurological Restoration

Staff Listing

Kenneth Baker, Ph.D.
Nicholas Boulis, M.D.
Scott Cooper, M.D., Ph.D.
Darlene Floden, Ph.D.
Monique Giroux, M.D.
Ilia Itin, M.D.
Cynthia Kubu, Ph.D.
Donald Malone, M.D.
Andre Machado, M.D., Ph.D.
Jerrold Vitek, M.D., Ph.D.
Benjamin Walter, M.D.

Center for Neuroradiology
Center Overview

Thomas J. Masaryk, M.D., Director

- Specialists perform structural and functional imaging of the central nervous system for the diagnosis of neurological lesions, injury or metabolic disease.
- Expertise in full range of imaging technologies:
  - computerized tomography (CT)
  - diffusion tensor imaging (DTI)
  - magnetic resonance imaging (MRI)
  - functional MRI (fMRI)
  - neurovascular ultrasound
  - positron emission tomography (PET)
  - single photon emission tomography (SPECT)
  - 3-D post-processing
- Diagnostic subspecialty areas of expertise include cerebrovascular disease, spine imaging, pediatric neuroradiology, otolaryngology, epilepsy, MR angiography, transcranial Doppler and carotid ultrasound.
- Specialized interventional neuroradiology services integrated with the Cerebrovascular Center include management of acute stroke, internal/external carotid artery embolizations, GDC coil occlusion of intracranial aneurysms, treatment of vasospasm and atherosclerotic occlusive disease and carotid artery stenting.
- In 2006, physicians in the Center read 35,000 neurological MRIs and 25,000 neurological CTs for the Cleveland Clinic hospitals and Family Health Centers.
- In collaboration with the endovascular group, Center physicians performed more than 2,000 neuroangiograms in 2006.
- Subspecialty neuroradiology consultative services on complex or unusual cases are digitally provided to hospitals nationwide through Cleveland Clinic e-Radiology.

Staff Listing

Neil Borden, M.D.
Jay Costantini, M.D.
Todd Emch, M.D.
David Fiorella, M.D., Ph.D.
Michael T. Modic, M.D., F.A.C.R.
Doksu Moon, M.D.
Micheal Phillips, M.D.
Paul Ruggieri, M.D.
Alison Smith, M.D.
Todd Stultz, D.D.S., M.D.
Andrew Tievsky, M.D.
Michelle Whiteman, M.D.

Center for Pediatric Neurology and Neurosurgery |

Directors' Letter

The Center for Pediatric Neurology and Neurosurgery is pleased to present statistics for some of our activities in 2006 that illustrate the depth and breadth of our program. Within the setting of the Neurological Institute, our team of board-certified physicians and surgeons offers a wide array of subspecialized services and technologies in every area of pediatric neurology and neurosurgery with excellent outcomes.

The data and descriptions you find in the following pages provide not only an overview of our Center, but also depict its standing within the national and international pediatric neurology/neurosurgery community. We are proud of our accomplishments; at the same time, we realize these subspecialty areas are rapidly evolving and we must continue to stay ahead of the curve if we are to provide optimal care for our patients. This is why we believe outcomes reporting is an important exercise. By continuously monitoring our performance, we strive to maintain the highest level of clinical care as well as identify opportunities for improvement.

This information was developed to be shared with referring physicians, potential patients, alumni, donors, and individuals interested in the status of pediatric neurology and neurosurgery at Cleveland Clinic. We hope you find it useful.

Elaine Wyllie, M.D.
Director, Center for Pediatric Neurology

Mark Luciano, M.D., Ph.D.
Director, Center for Pediatric Neurosurgery

Center for Pediatric Neurology and Neurosurgery |

Center Overview

Pediatric Neurology

- Total outpatient visits in 2006 reached 5,827. The top six leading diagnoses were headache, Tourette syndrome and tics, metabolic and mitochondrial disorders, epilepsy, neuromuscular diseases and neurofibromatosis. Neurological conditions treated:
  - brain and spinal cord tumors
  - brain malformations
  - cerebral palsy and spasticity
  - epilepsy
  - fetal and neonatal neurological problems
  - headache
  - metabolic and mitochondrial disorders
  - neurological complications of cardiac disease
  - neuromuscular disease and muscular dystrophy
  - stroke
  - Tourette syndrome and other movement disorders
  - white matter disease
- All staff members are board-certified in both pediatrics and neurology and several are listed among the top physicians in Ohio and the United States.
- Nationally and internationally renowned center for the diagnosis and treatment of Tourette syndrome and other pediatric movement disorders, including dystonia and ataxia.

- Specialized diagnostic techniques include DNA tests, pediatric EMG, neuropathological examination of nerve and muscle biopsies, specialized laboratory testing (including molecular genetics), state-of-the-art imaging (including brain MRI, MRA), cerebral angiogram and CT angiogram.
- State-of-the-art therapeutics: drug trials, plasmapheresis, immunoglobulin infusion for neuromuscular diseases, botulinum toxin injections guided by EMG and deep brain stimulation for movement disorders, oral medications, physical therapy, orthopaedic baclofen infusion and selective dorsal rhyzotomy for spasticity and cerebral palsy; specialized interventions for spina bifida and myelomeningocele; emergency intravenous infusions for headache crises.

Pediatric and Congenital Neurosurgery

- Nationally recognized as center for pediatric neurosurgery, hydrocephalus, and neuroendoscopy.
- In 2006, pediatric and congenital neurosurgeons performed a broad range of pediatric neurosurgery services including tumors, spasticity, and hydrocephalus in addition to treating adults with congenital neurosurgical disorders and Chiari malformation.
- Pediatric neurosurgery cases made up over 200 of the total cases with an additional 160 patients treated for normal pressure hydrocephalus.
- Total volume of procedures treated for congenital malformations continues to grow. More than half the patients treated for these conditions are adults.
- Treatments for diagnoses such as Chiari malformation using neuroendoscopic techniques are also growing. This technique results in smaller scars, faster recovery and a decreased infection and complication rate.

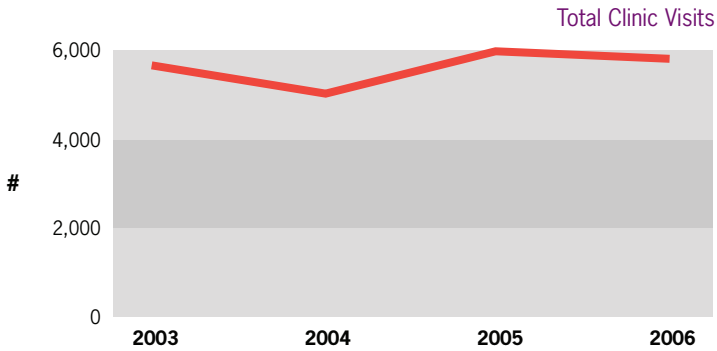
- Multidisciplinary spasticity clinic provides evaluation and treatment for children and young adults with spasticity due to cerebral palsy or brain injury. Available treatments include:
  - Adjunctive medications such as Botox
  - Combined orthopaedic and neurosurgical procedures
  - Physical therapy
  - Selective dorsal rhizotomy with baclofen pump implantation
- Neurosurgeons performed more than 50 procedures for Chiari malformation in 2006 with an average length of stay of less than three days.
- Patient volume for treatment of pediatric brain tumors continues to increase; average length of stay remains less than nine days; stereotactic and endoscopic biopsy procedures are routinely used.
- Specialists treat hydrocephalus in premature infants from Cleveland Clinic's NICU and NICUs from surrounding area hospitals using shunting or endoscopic procedures.
- State-of-the-art adjustable, antibiotic-impregnated shunt systems provide the most effective defense against drainage problems and infection; follow-up shunt clinic provides regular monitoring.
- Pediatric neurosurgeons annually perform approximately 300 hydrocephalus procedures in pediatric and adult patients with an average length of stay of less than six days.
- Use of endoscopic third ventriculostomy as an alternative to shunting in patients with aqueductal stenosis continues to increase; average length of stay is 3.5 days.

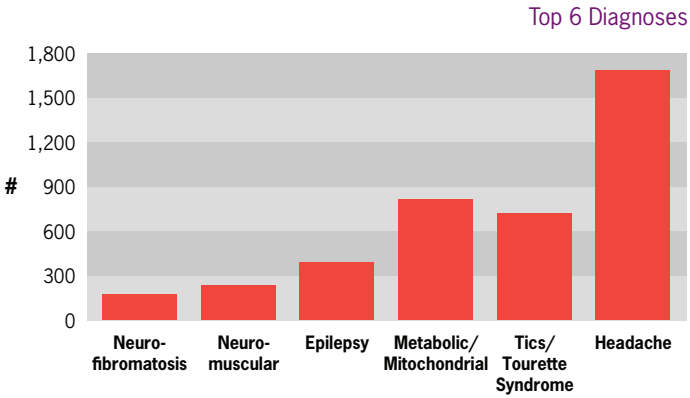
Center for Pediatric Neurology and Neurosurgery |

Quality & Outcome Measures

Pediatric Neurology

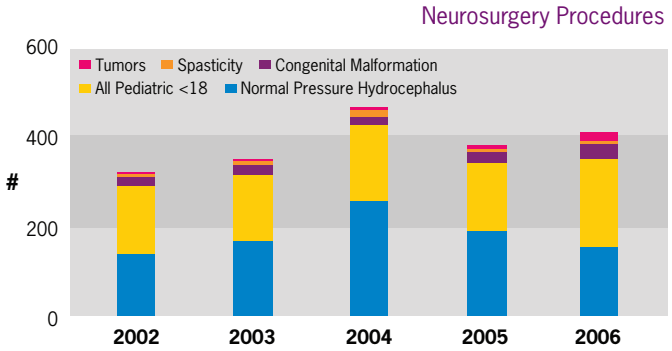
In 2006, nearly 6,000 patients were seen in the pediatric neurology outpatient clinic.

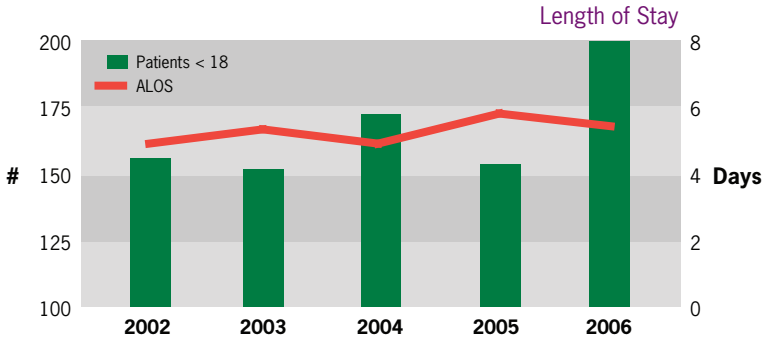


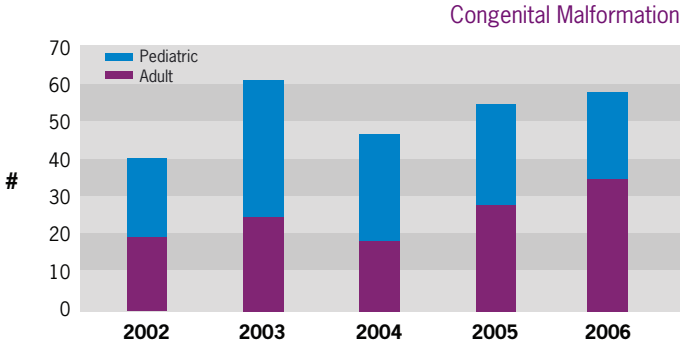


Pediatric and Congenital Neurosurgery

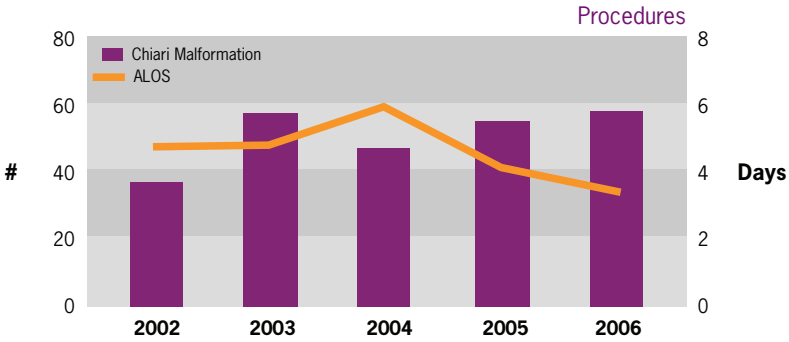
The Pediatric and Congenital Neurosurgery Section provides a broad range of pediatric neurosurgery services and cares for adults with congenital neurosurgical disorders and hydrocephalus. In 2006, procedure volume and average length of stay (ALOS) continued to trend upward.



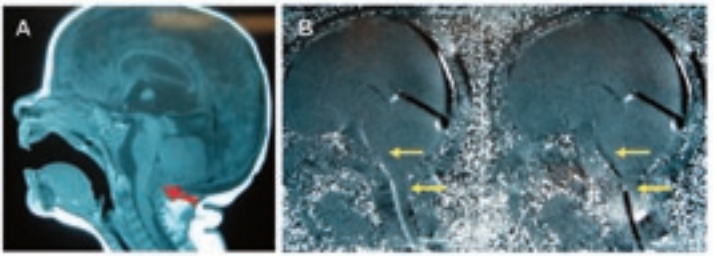




In 2006 adult procedures (n=35) outnumbered pediatric procedures (n=23) for congenital malformations. Total surgical volume has been increasing since 2004.



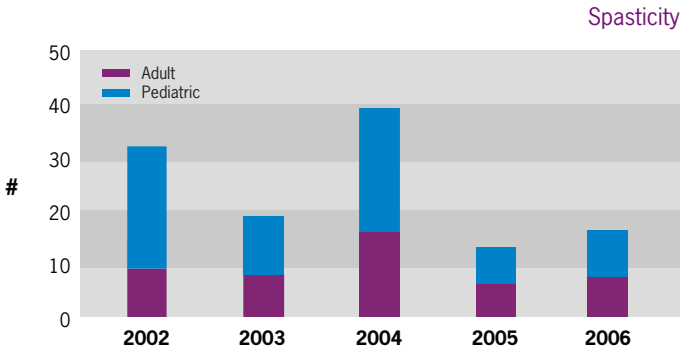
Chiari Malformation (CM) is a congenital anomaly which may or may not be apparent at birth, usually causing symptoms in young adults. CM is also associated with myelomeningocele and hydrocephalus, which are frequently apparent at birth. The condition is characterized by a downward displaced herniation of the lower part of the brain (cerebellar tonsils) into the upper portion of the spinal canal. This herniation can occur with or without descent of the brain stem. This herniation causes compression of the spinal cord and nerves, which can result in symptoms of head and neck pain, muscle weakness, loss of temperature sensation, loss of bowel and bladder control, and spinal deformities. CM is often associated with syringomyelia, in which a tubular cavity develops within the center of the spinal cord. Syrinx occurs if the herniation blocks normal flow of cerebrospinal fluid that enters the spinal cord.

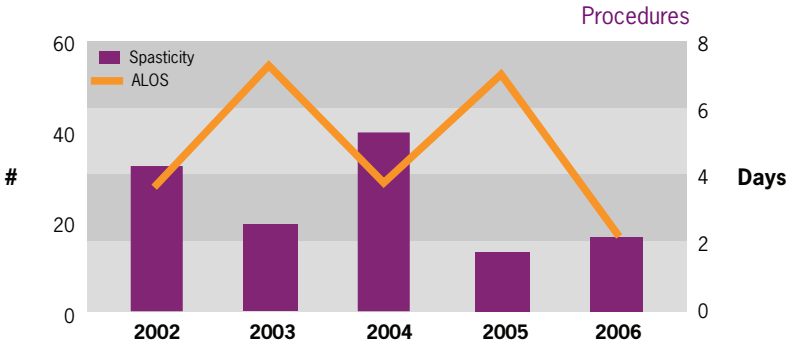


Sagittal MRI (A) showing downward displacement (red arrow) of the cerebellum causing herniation of the brainstem and spinal cord. MR CINE Flow technique (B) showing obstructed cerebrospinal fluid movement from the brain to the brain stem and spinal spaces (yellow arrows).

Whenever possible, Center physicians use an endoscopic-assisted neurosurgical procedure developed at Cleveland Clinic for the treatment of CM. During the neuroendoscopic procedure, the surgeon uses a special instrument with a small camera and light source to see inside the brain through small incisions. This leads to smaller scars, a quicker recovery and a decreased infection and complication rate. The growing use of this new procedure is reflected in declining length of stay.

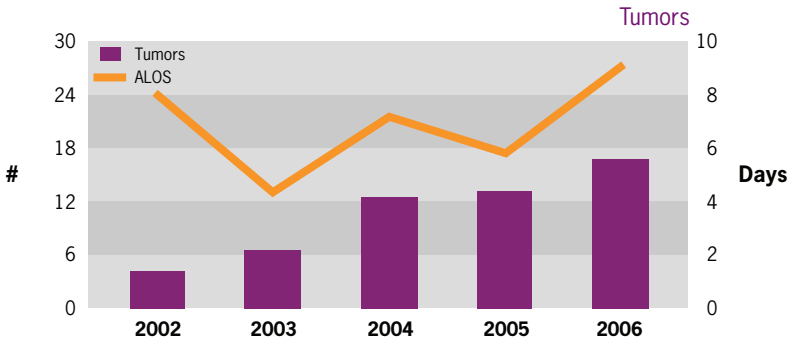
The Spacticity Clinic treats children and young adults with spacticity due to cerebral palsy or other brain injury. A full range of treatment options is available, including combined orthopaedic and neurosurgical procedures, physical therapy and adjunctive medications such as Botox. Selective dorsal rhizotomy is a surgical procedure involving the implantation of an intrathecal pump to deliver Baclofen and the interruption of hyperactive neural fiber.





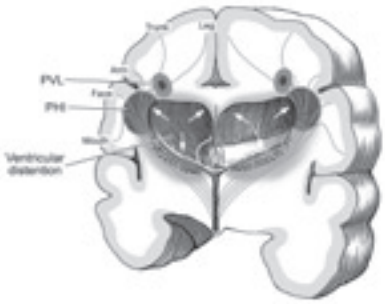
Tumors

The number of pediatric tumor cases treated annually increased significantly every year since 2002. The highest number of patients were treated in 2006. Average length of stay (ALOS) remains less than 10 days since 2001.



Navigational neuroendoscopy was pioneered at Cleveland Clinic, allowing simultaneous computer and visual guidance to brain targets. Small, deep tumors are located and treated with the navigated neuroendoscope allowing a minimally invasive approach, reducing the size of the incision and damage to the brain.

Hydrocephalus



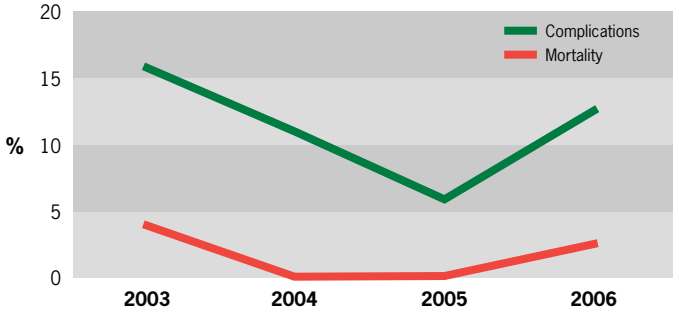
Premature infants who develop hemorrhage and hydrocephalus are treated early with shunting and, in later childhood, treated for spasticity.

Ventriculoperitoneal shunting is one of the most common pediatric neurosurgical procedures.

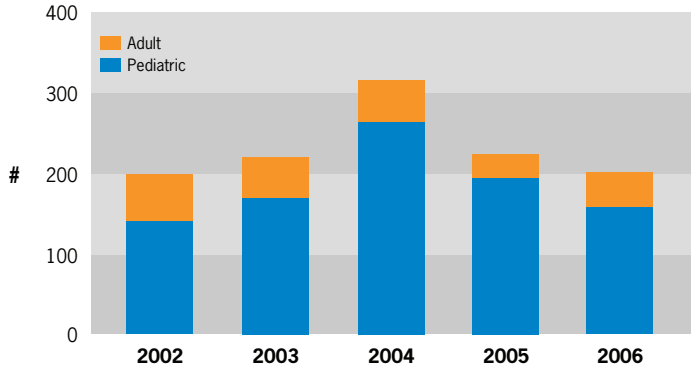
Normal pressure hydrocephalus (NPH) is a form of chronic communicating hydrocephalus characterized by normal intracranial pressure and enlarged ventricles on radiographic imaging. The triad of symptoms classically associated with NPH is gait disturbance, urinary incontinence and cognitive impairment. Although the majority of patients do not demonstrate all three findings, the hallmark symptom is a shuffling or "magnetic" gait. The gait disorder of NPH is often confused with Parkinson's disease, frontal lobe dementia, Alzheimer's disease, spinal canal stenosis and even normal aging.

Treatment for hydrocephalus involves the surgical implantation of a shunt which diverts the excess cerebrospinal fluid from the brain or spinal canal to another part of the body where the fluid is easily and safely absorbed.

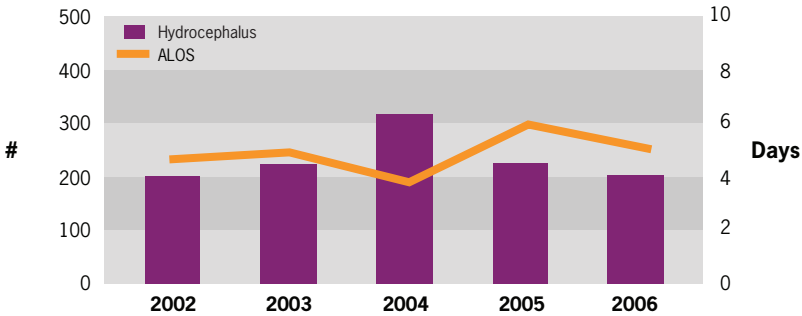
Newly Diagnosed NPH Cases



Procedures



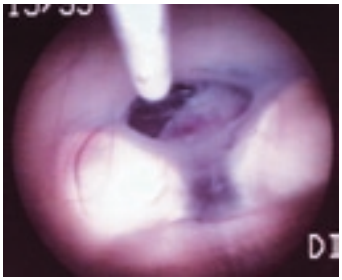
ALOS



Endoscopic Third Ventriculostomy (ETV)

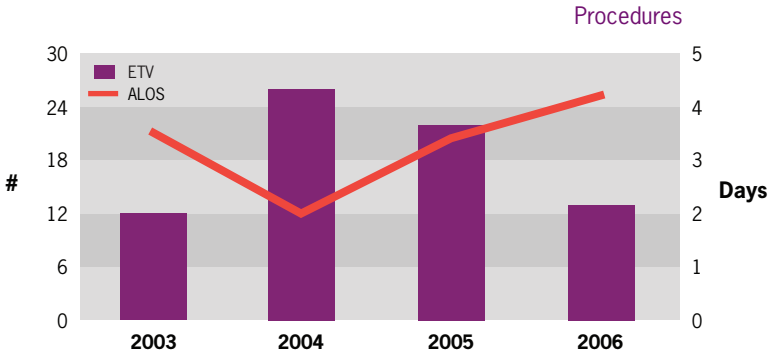
Endoscopic third ventriculostomy is a state-of-the-art alternative for treating hydrocephalus. By passing a tiny viewing scope into the ventricle, the surgeon can view images from the brain's ventricular system interior, projected onto a monitor located next to the operating table.

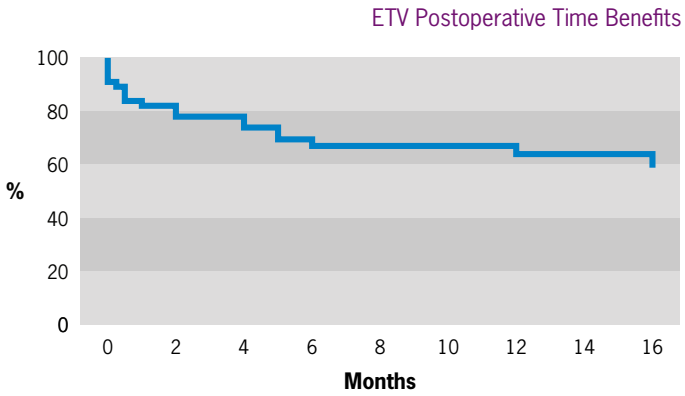
ETV involves surgically redirecting (yellow arrow) cerebrospinal fluid that is obstructed.



Intraoperative image during the ETV procedure showing the floor of the third ventricle and the fenestration (hole) made to redirect fluid into the basal cistern.

The objective of ETV is improve cerebrospinal fluid (CSF) circulation (*i.e.*, compliance) by redirecting CSF that is trapped within the brain through a small hole/fenestration in the floor of the third ventricle, allowing CSF to exit into the subarachnoid space at the base of the brain. (Note: Intracranial pressure is less likely to change since the skull is a continuous, fluid-filled cavity).





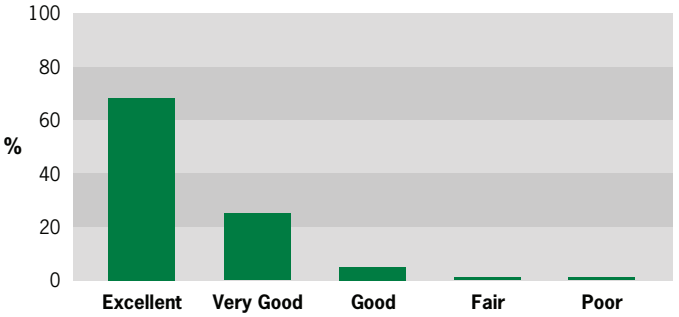
Approximately 60% of patients who undergo ETV continue to experience improvement as long as 16 months post-treatment.

Center for Pediatric Neurology and Neurosurgery

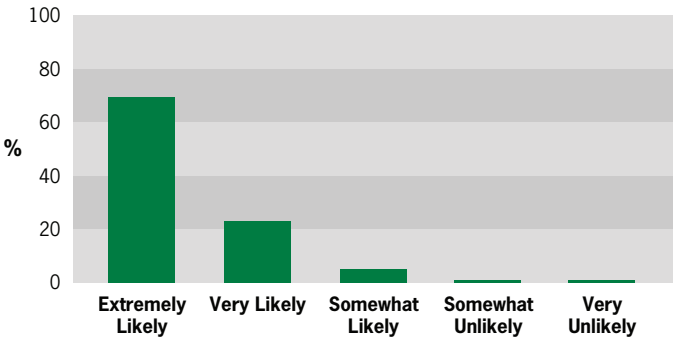
Patient Experience

We ask our patients about their experiences and satisfaction with the services provided by our staff. Although our patients are already indicating we provide excellent care, we are committed to continuous improvement.

Outpatient
Overall Rating of Care



Outpatient
Would Recommend Provider



Center for Pediatric Neurology and Neurosurgery |

Innovations

- Founding member of the Ohio Pediatric Stroke Consortium and its Pediatric Stroke Registry.
- Development of a multidisciplinary day program with the Cleveland Clinic Children's Rehabilitation Hospital for treatment of persistent chronic headache.
- Establishment of a team for diagnosis and treatment of neurometabolic and neurogenetic disorders causing white matter degeneration, mental retardation, or epilepsy.
- Development of a Fetal Care Center for diagnosis and treatment of a variety of prenatal and newborn conditions affecting the brain and spinal cord.
- Development of innovative approaches to selection of pediatric candidates for epilepsy surgery.

Center for Pediatric Neurology and Neurosurgery |

New Knowledge

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Center for Pediatric Neurology and Neurosurgery | Directors

Staff Listing

Elaine Wyllie, M.D.
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Mark Luciano, M.D., Ph.D.
Director, Center for Pediatric Neurosurgery

Staff Listing

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Debabrata Ghosh, M.D., D.M.
Gary Hsich, M.D.
Irwin Jacobs, M.D.
Manikum Moodley, M.B., Ch.B.
Sumit B. Parikh, M.D.
A. David Rothner, M.D.

Center for Spine Health |
Director's Letter

Center for Spine Health is pleased to present our 2006 outcomes. These data highlight the efforts and accomplishments of our multidisciplinary team of medical and surgical specialists and mid-level health care providers. The close collaboration between neurosurgical, orthopaedic and medical spine specialists within the Center has optimized the implementation of individualized diagnostic strategies and has facilitated the delivery of high quality patient care. Innovative solutions to complex clinical problems, that could rarely be achieved elsewhere, are commonplace in the Center for Spine Health.

In the pages that follow, both our overall throughput and selected programs are portrayed and displayed. We are particularly proud of our history of innovation and the impact that it has had on clinical care. Therefore, we also have provided a snapshot of our successes in this arena.

Center for Spine Health is alive and well. Quality patient care is our product. Quality information gathering and processing is the method by which we measure ourselves and the tool by which we optimize treatment. What follows represents a look at the Center in 2006. It also provides a glimpse of what it might look like tomorrow. Read and enjoy.

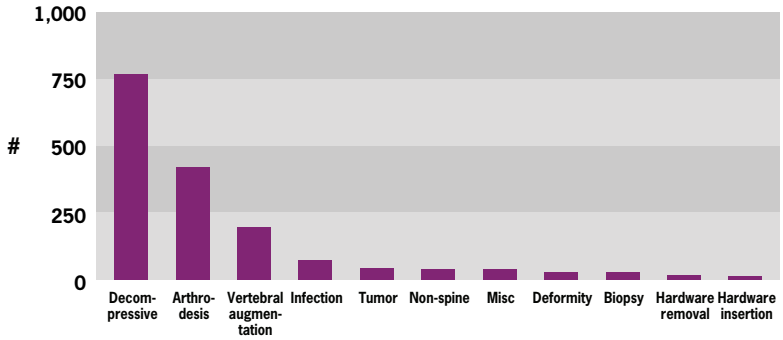
Edward C. Benzel, M.D.
Director, Center for Spine Health

Center for Spine Health
Center Overview

- Provides medical and surgical management for the full scope of back and spine problems with services at main campus, Lorain, Willoughby Hills and Independence Family Health Centers, Euclid Hospital and Lutheran Hospital.
- Nearly 24,000 patients treated annually, including patients from all over the world.
- Treatment begins whenever possible with nonsurgical options such as medication, pain management, bracing, manipulation or physical therapy.
- One of the highest success rates in the country for spinal surgery.
- Pioneered many surgical and minimally invasive surgical techniques now in use around the world.
- Performed 2,561 procedures, including 764 decompressions, 420 spinal fusions and 197 spinal augmentations.
- Degenerative spine, the most common surgical diagnosis, accounted for 1,000 procedures followed by spinal deformity, 366 procedures.
- Subspecialty programs address the needs of the mature spine, spine wellness, pediatric and adolescent spine disorders, Chiari syringomyelia and chronic back pain.
- Spine Tumor Board, established in 2006, provides a combined, multi-disciplinary approach to the decision-making and treatment process for primary and metastatic spinal tumors. Reviewed 113 cases in its first year: 68 primary tumors and 45 metastatic tumors.
- Spine Research Laboratory conducts research in spinal cord injury, spine biomechanics, MEMS (Micro Electro Mechanical Systems), outcomes and tissue engineering/molecular biology.
- A Spine Clinical Outcome Information System (SCOIS) allows physicians to construct an accurate, digital depiction of their patient populations, interactions with patients and clinical effectiveness associated with these interactions.

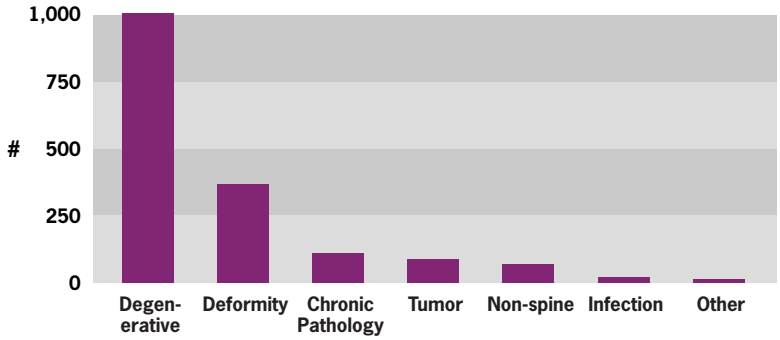
Center for Spine Health |
Quality & Outcome Measures

Procedures by Category



Spinal decompression continues to be the most frequently performed procedure by Center for Spine Health physicians.

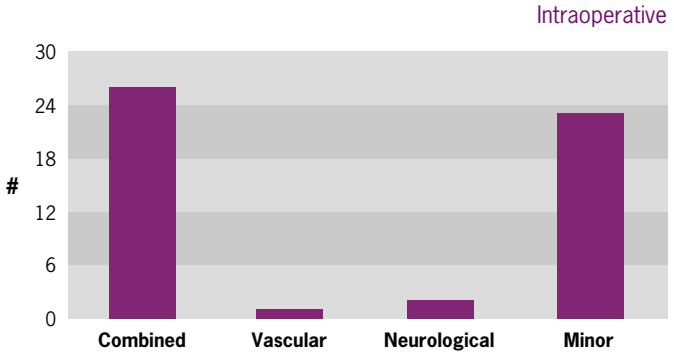
Cases by Diagnostic Group

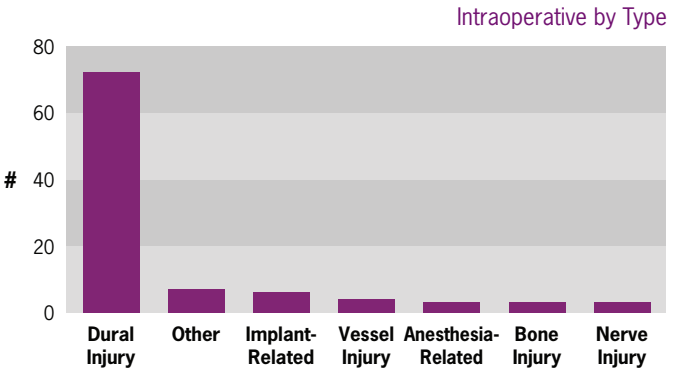


Degenerative conditions of the spine are by far the most common diagnosis, followed by spinal deformities.

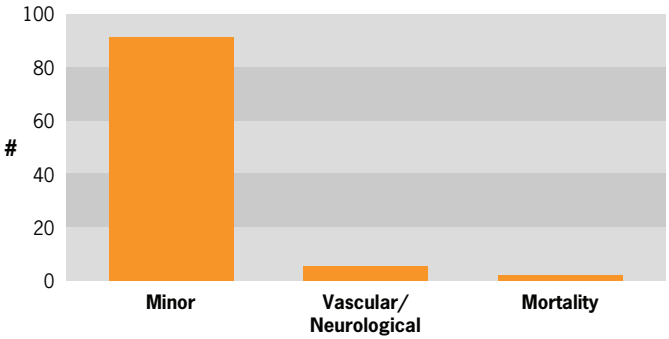
Complications

For clarification, intraoperative complications are divided into the following categories: minor (*e.g.*, dural tear, anesthesia-related problem), vascular (*e.g.*, vessel injury), and neurological (*e.g.*, spinal cord or nerve injury). The combined complication rate represents 5.9% of the total cases; the majority (5.5%) were minor.

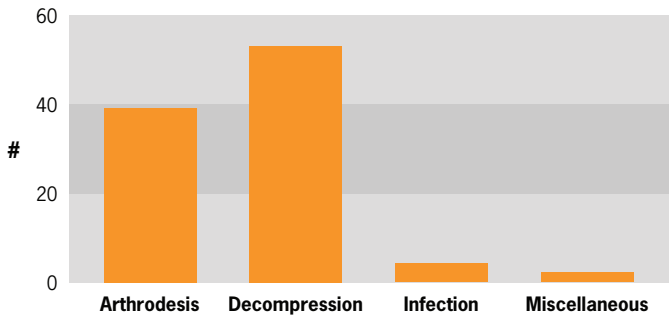




Intraoperative by Severity



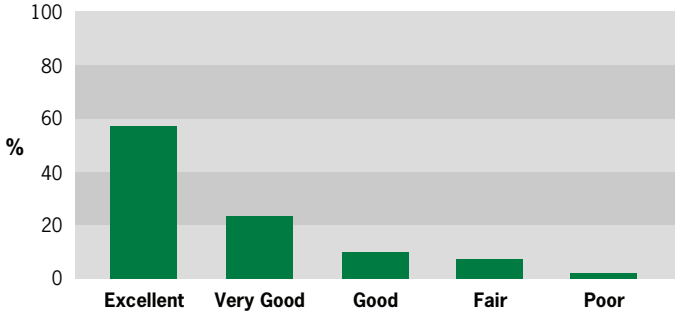
Intraoperative by Procedure



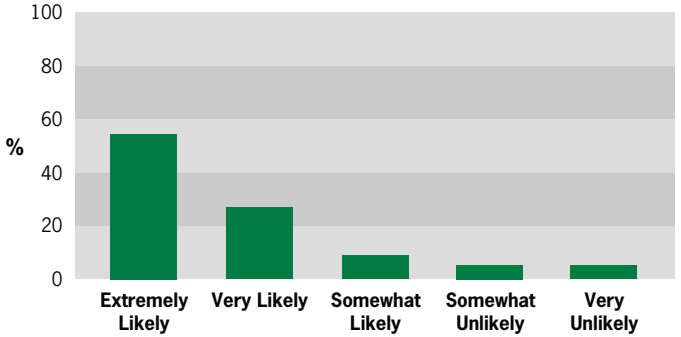
Center for Spine Health
Patient Experience

We ask our patients about their experiences and satisfaction with the services provided by our staff. Although our patients are already indicating we provide excellent care, we are committed to continuous improvement.

Outpatient
Overall Rating of Care



Outpatient
Would Recommend Provider



Service Excellence
Innovations

- Development of OrthoMEMS, a pressure-distribution sensor for implantation in an artificial joint
- Development of the Merlot Screw
- Development of Axiomed

Center for Spine Health
New Knowledge

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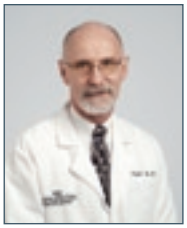
Center for Spine Health | Director
Staff Listing



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Michael Steinmetz, M.D.
Santosh Thomas, D.O.
Fredrick Wilson, D.O.
Adrian Zachary, D.O., M.P.H.

Cerebrovascular Center

Director's Letter

The Cerebrovascular Center is pleased to present our 2006 outcomes, highlighting our comprehensive approach to the prevention, diagnosis and management of stroke and other vascular disorders of the brain. Our services range from diagnostic angiograms and stenting of the carotid arteries to emergency treatment of acute stroke and other blockages of the brain. In addition, we offer cutting-edge, minimally invasive treatment of brain aneurysms and arteriovenous malformations (AVMs). The data presented on the following pages provide an overview of the Center and highlight its position as a leader in cerebrovascular medicine.

In the current era of rapid advances in stroke prevention, diagnosis and treatment, our staff members remain committed to providing optimal care that allows patients to enjoy the highest possible quality of life. We strongly believe in sharing our outcome data, research and innovations with our colleagues so that we may advance our collective knowledge to benefit patients.

We hope you find the information helpful and informative. We look forward to continued collaboration and excellence in the care of our patients.

Peter Rasmussen, M.D.
Director, Cerebrovascular Center

Cerebrovascular Center

Center Overview

- Offers diagnosis and treatment for the full spectrum of cerebrovascular conditions and diseases, including:
  - acute stroke
  - arteriovenous malformations and cavernous malformations
  - carotid occlusive disease (stenosis)
  - cerebral aneurysms
  - head and neck vascular malformations
  - intracerebral hemorrhage
  - intracranial atherosclerotic disease
  - spine and spinal cord vascular malformations
  - transient cerebral ischemia (TIA)
- Diagnostic capabilities include angiography, inferior petrosal sinus sampling for Cushing's disease and provocative neurologic testing (WADA).
- Specialized interventional techniques:
  - angioplasty and stenting for intracranial atherosclerotic disease, including CVA, cervico-cerebral atherosclerosis and transient cerebral ischemia
  - carotid endarterectomy and carotid angioplasty and stenting for carotid occlusive disease
  - microsurgical clipping and endovascular (coil embolization) treatment for cerebral aneurysms
  - microsurgical resection, embolization and Gamma Knife stereotactic radiosurgery for brain and spinal cord vascular malformations

- More than 600 admissions in 2006; average length of stay was 12 days for ruptured aneurysm and 3.5 days for unruptured aneurysm.
- Active stroke prevention program is certified by Joint Commission as a Primary Stroke Center and was a 2003 recipient of the Joint Commission Codman Award for excellence in systems approach to stroke care.
- The stroke neurologists are recognized leaders in the use of tPA for stroke. Center participates in the American Stroke Association's "Get with the Guidelines" program to ensure quality improvement in acute stroke treatment and ischemic stroke prevention.
- Specialists in neurocritical care treat patients with elevated intracranial pressure, hemorrhagic stroke, hepatic encephalopathy, encephalitis, status epilepticus, Guillian-Barre syndrome, traumatic brain injury, subarachnoid hemorrhage and malignant hemispheric stroke.
- One of the highest stroke-related patient volumes in North America with more than 3,200 outpatient visits annually.
- Nearly 500 interventional endovascular therapeutic procedures were performed in 2006.

Cerebrovascular Center

Quality & Outcome Measures

"Get with the Guidelines"
Stroke Treatment Quality Measures

Clinical Measure	Minimum	Goal	Cleveland Clinic
DVT prophylaxis	79.7%	85.0%	91.3%
Antithrombotics <48 hrs. after admit	85.0%	92.8%	96.7%
Antithrombotics at discharge	85.0%	96.2%	96.2%
Anticoagulation for Afib	85.0%	97.0%	97.0%
tPA (Eligible <2hrs. after arrival)	54.1%	85.0%	85.0%
Statin at discharge (LDV≥100)	78.3%	85.0%	85.0%
Smoking counsel	75.6%	85.0%	85.0%
Dysphagia screening prior to PO	59.6%	85.0%	85.0%

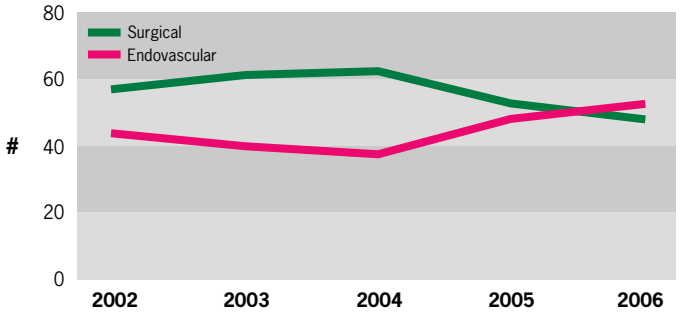
Cleveland Clinic exceeds the "Get with the Guidelines" goals for six of eight quality indicators, falls between the minimum percentage and the goal for one and is less than the minimum percentage for one indicator.

Cerebrovascular and Endovascular Neurosurgery

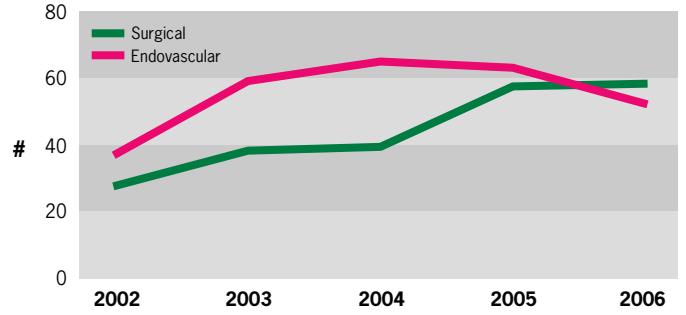
Treatment of ruptured and unruptured brain aneurysms and AVMs continues to outnumber all other cerebrovascular surgical procedures. Occlusive cerebrovascular disease, carotid bifurcation and intracranial atherosclerosis represent the second largest patient group. Other groups include intracranial and intraspinal vascular malformations.

Treatment of hemorrhagic stroke due to ruptured aneurysms has changed over the last 10 years. As well as the commonly applied technique of microsurgical clipping, endovascular neurosurgeons also use detachable coils, Y-Stents and Onyx embolic system to treat aneurysms and AVMs. These techniques secure the aneurysm or AVM to prevent further hemorrhage. Less invasive surgery results in shorter length of stay and faster return to work for patients.

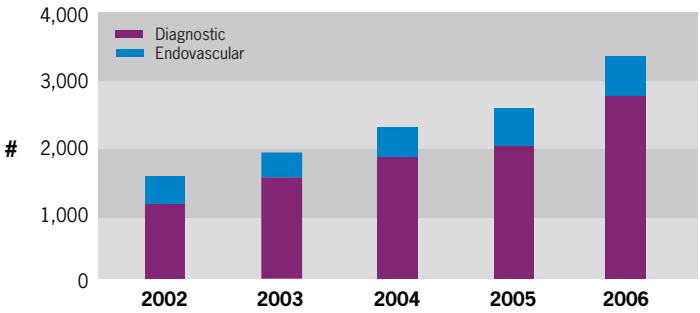
Ruptured Aneurysms



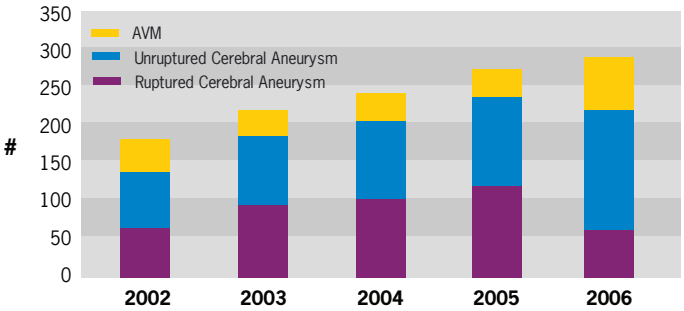
Unruptured Aneurysms



Procedures

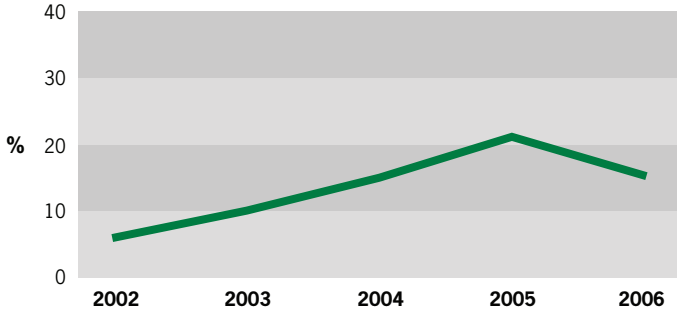


Case Distribution

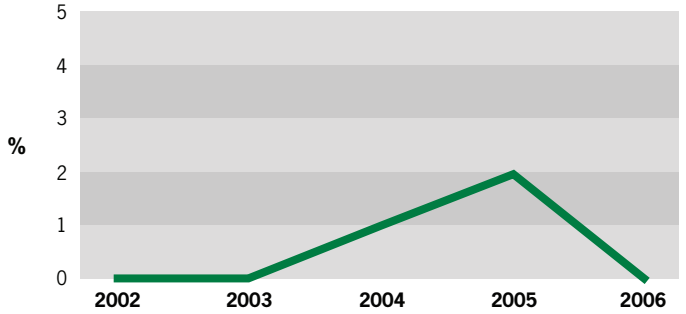


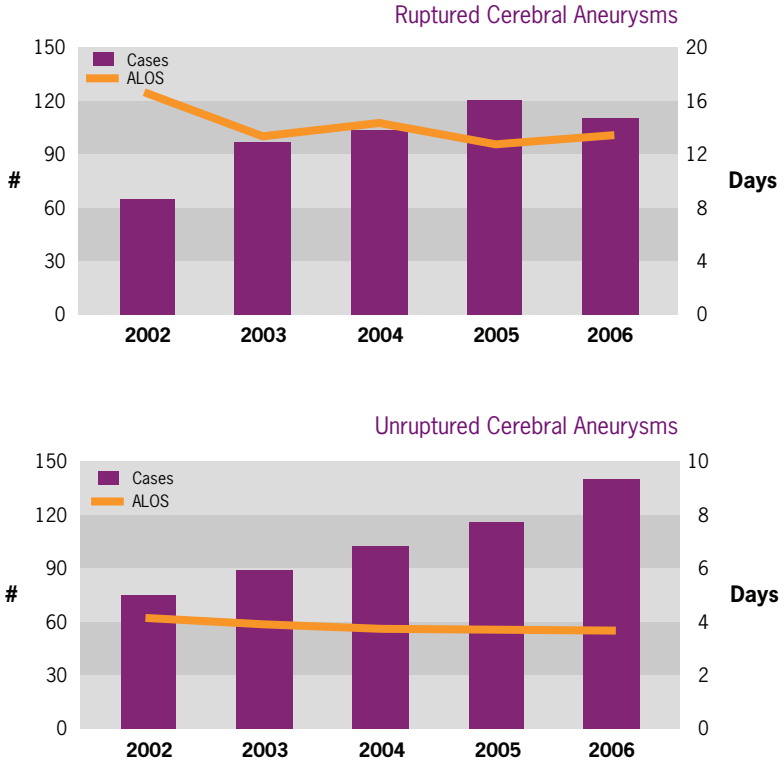
After several years of a slight upward trend in mortality statistics for ruptured and unruptured aneurysms (reflecting case complexity), mortality declined slightly in 2006.

Ruptured Aneurysm Mortality



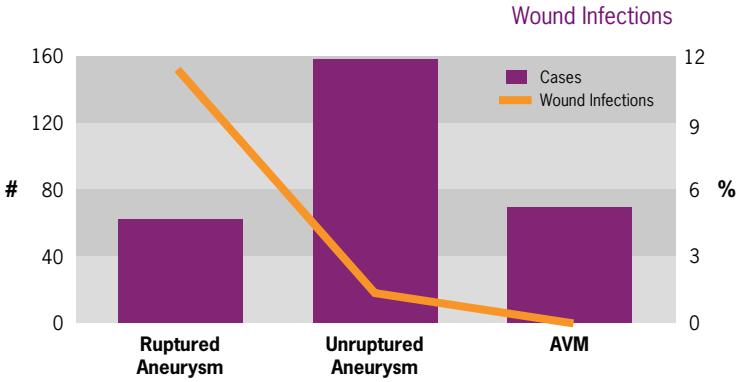
Unruptured Aneurysm Mortality





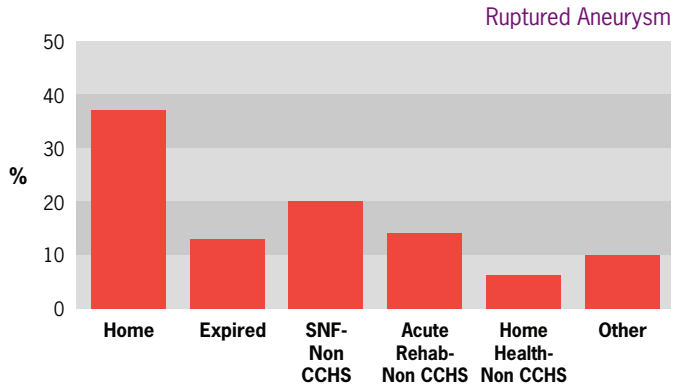
Numbers of patients undergoing endovascular treatment of cerebral aneurysms and those undergoing surgical treatment were approximately equivalent in 2006. The average length of stay (ALOS) for patients undergoing treatment for unruptured aneurysms via the endovascular approach is usually less than 24 hours. For patients treated for unruptured aneurysms that require an inpatient stay, length of stay remained consistent at an average of 3.5 days. Length of stay for a ruptured aneurysm has also been trending lower over the past few years. Even though the large number of co-morbidities can adversely affect length of stay, the unique approach of multidisciplinary care offsets these numbers.

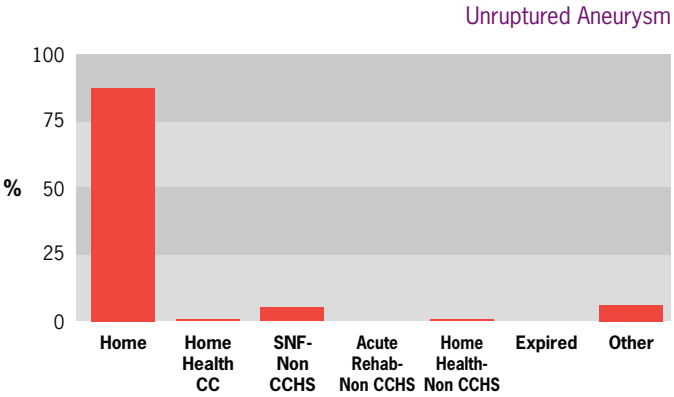
The rate of surgical infection in proportion to the number of cases performed each year indicates the positive outcome of patients treated for cerebrovascular disease.



Discharge

Even with the increase in co-morbidities and number of procedures, most patients with ruptured and unruptured aneurysms are still discharged to the home. Changes to a more multidisciplinary physician team approach and minimally invasive endovascular surgical techniques are creating these positive changes in discharge statistics.



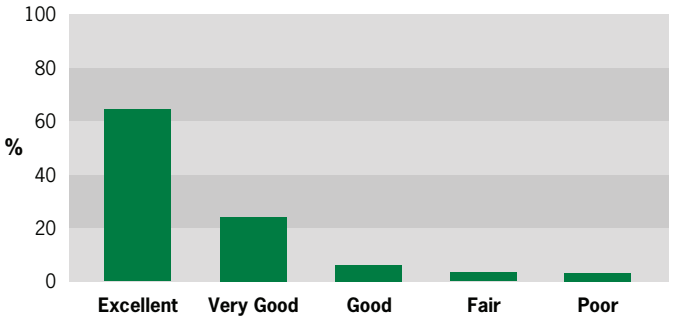


Cerebrovascular Center

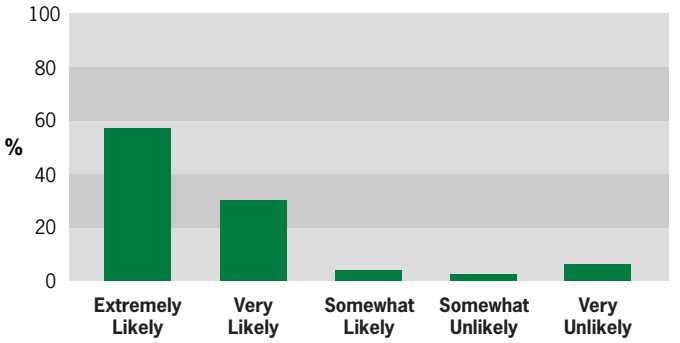
Patient Experience

We ask our patients about their experiences and satisfaction with the services provided by our staff. Although our patients are already indicating we provide excellent care, we are committed to continuous improvement.

Outpatient
Overall Rating of Care



Outpatient
Would Recommend Provider



Cerebrovascular Center |

Innovations

- Study of the effect of desmoteplase in acute ischemic stroke during the three-to-nine-hour window following stroke onset.
- Establishment of a multicenter clinical registry of the Gateway PTA Balloon Wingspan Stent System for treatment of intracranial atheromatous disease to better define safety and efficacy profiles and characterize the technical performance of this device.

Cerebrovascular Center

New Knowledge

Abou-Chebl A, Reginelli J, Bajzer C, Yadav J. Intensive treatment of hypertension decreases the risk of hyperperfusion and intracerebral hemorrhage following carotid artery stenting. *Catheterization Cardiovasc Interv* 2006; In press.

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Cerebrovascular Center | Director
Staff Listing

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Director, Cerebrovascular Center

Staff Listing

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Associate Director, Cerebrovascular Center
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Derk Krieger, M.D.
Gwendolyn Lynch, M.D.
Thomas Masaryk, M.D.
J. Javier Provencio, M.D.
Cathy Sila, M.D.
Henry Woo, M.D.

Epilepsy Center
Director's Letter

Creation of the Cleveland Clinic Epilepsy Center within the Neurological Institute in 2006 unites medical and surgical epilepsy treatment into a single, collaborative entity. We believe this new structure will facilitate our mission of delivering world-class care for patients with epilepsy by providing cutting-edge clinical management through the use of state-of-the-art diagnostic, therapeutic and surgical techniques.

Cleveland Clinic Epilepsy Center is recognized nationally and internationally as one of the premier comprehensive epilepsy programs in the field. Under the same administrative structure, the Cleveland Clinic Epilepsy Center houses neurologists, neurosurgeons, neuroradiologists, psychiatrists and neuropsychologists whose main interest centers on the management of various epileptic conditions. To maintain our leadership position, our staff members are deeply involved in clinical and translational research to improve the diagnosis and treatment of epilepsy and in training physicians from around the world to become leading epileptologists.

The outcomes data and descriptions presented in the following pages highlight our achievements in 2006 and set the stage for future direction. Beyond our state-of-the-art technology and the latest techniques, however, we believe providing the best epilepsy care also means providing care with compassion and understanding.

We hope you find the information contained in this summary helpful and informative. As always, we welcome your referrals.

Imad Najm, M.D.
Director, Epilepsy Center

Epilepsy Center

Center Overview

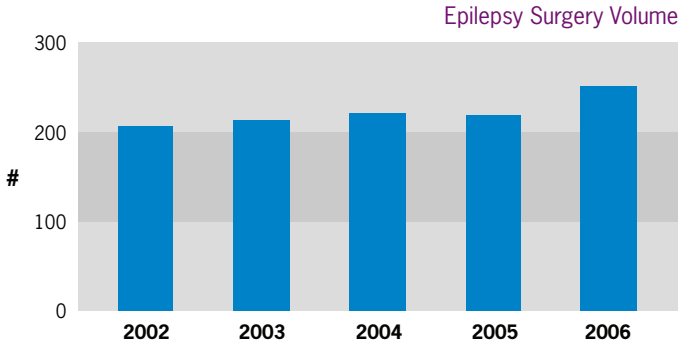
- One of the largest and most comprehensive epilepsy centers in the world for the medical and surgical evaluation and treatment of epilepsy in children and adults.
- Epileptologists care for more than 5,000 adult and pediatric patients each year from all over the world.
- Provides expert video electroencephalograph (EEG) monitoring performed in dedicated units to pinpoint the focus of seizures.
- Noninvasive techniques include EEG, video EEG, sphenoidal electrode EEG monitoring and evoked potential monitoring.
- Invasive video EEG monitoring techniques include subdural EEG electrodes, depth EEG electrodes and state-of-the-art brain mapping techniques (including electrical cortical stimulation and cortical somatosensory evoked potential [SSEP] techniques) developed at Cleveland Clinic.
- More than 5,300 EEG studies performed annually.
- More than 500 evoked potential studies performed annually.
- More than 250 epilepsy surgeries performed each year, including more than 80 pediatric procedures.

- Expertise in the full range of epilepsy procedures:
    - chronic invasive subdural monitoring
    - extra-temporal surgery
    - hemispherectomy
    - intraoperative electrocorticogram monitoring to detect seizure foci
    - lesionectomy
    - presurgical WADA testing
    - temporal lobectomy
    - vagal nerve stimulation.
- World-class neuroimaging capabilities, including MRI and functional MRI, PET, ictal SPECT, MRS and diffusion tensor imaging.
- Comprehensive treatment includes neuropsychological evaluation and epilepsy related psychiatric disease management.
- Expert management of non-epileptic seizures by a team of dedicated specialists, including epileptologists, adult and pediatric psychiatrists and social workers.

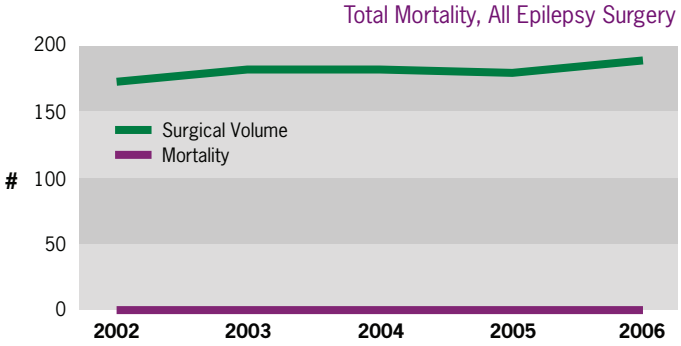
Epilepsy Center
Quality & Outcome Measures

Epilepsy Surgery

The Cleveland Clinic Epilepsy Surgery program is focused on the diagnosis, investigation, and treatment of surgical epilepsy, which has become increasingly more complex. Advances in monitoring and imaging techniques have allowed for the discovery of epilepsy foci not detectable a decade ago. Epilepsy surgery entails both resective and stimulation/palliative procedures. Our program enjoys an international referral base, large clinical volume, specialized expertise, and superior patient results.



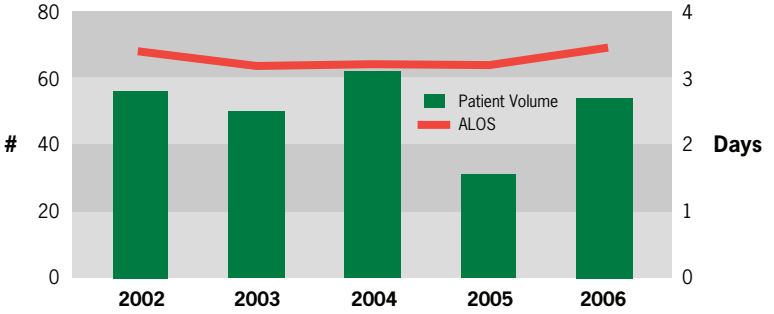
Our patients have experienced no surgical mortality in the last six years despite an increase in the number of complicated patients treated.



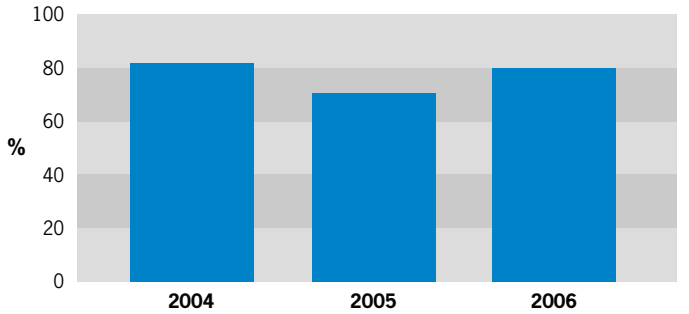
Temporal Lobectomy

Temporal lobectomy remains the single most common resective procedure for the treatment of medically intractable epilepsy in the adult patient population as well as the most successful. Patients experience an 80% or better rate of seizure freedom.

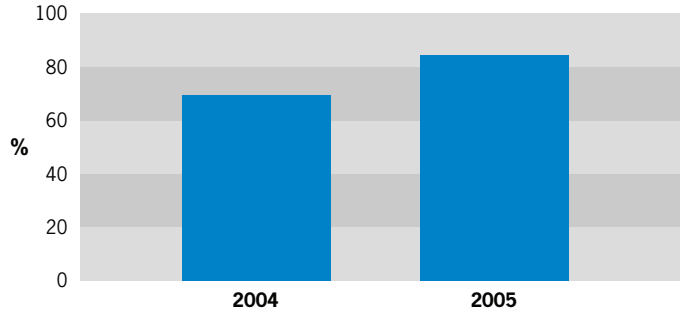
Adult Temporal Lobectomy



Adult Seizure Freedom at 6 Months

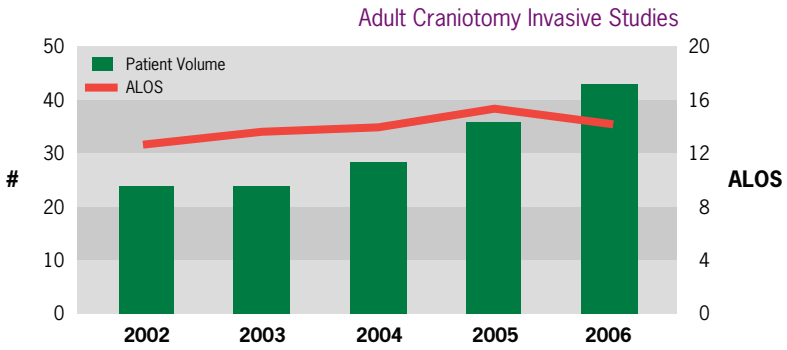


Adult Seizure Freedom at 1 Year

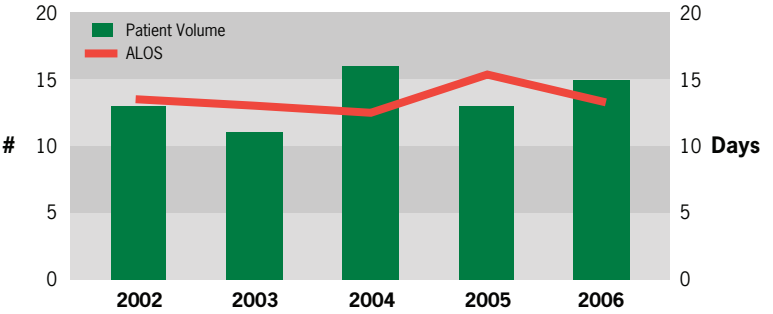


Invasive Monitoring

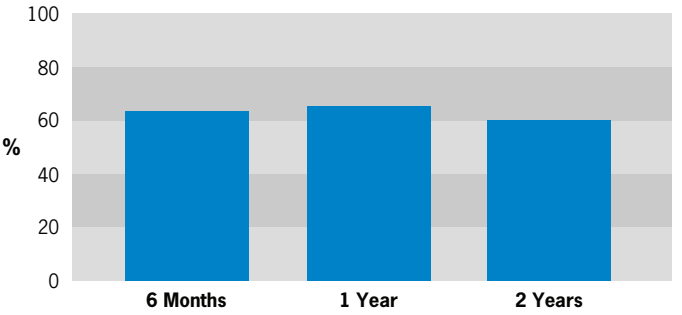
For a select group of patients, we are unable to determine the location of their seizure focus by noninvasive means, such as scalp EEG and MR imaging. This subgroup of patients requires surgery to implant subdural or depth electrodes over the suspected areas of the brain to better delineate the onset of seizures or to better define the function of the brain tissue around it. For example, seizures may start very close to one of the speech centers in the brain. Invasive monitoring can help to define how much the surgeon can remove while preserving neurological function.



Pediatric Craniotomy Invasive Studies

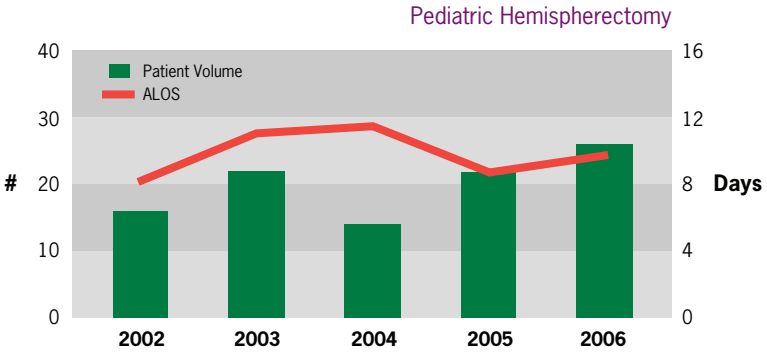


Seizure Freedom Following Invasive Monitoring, All Patients



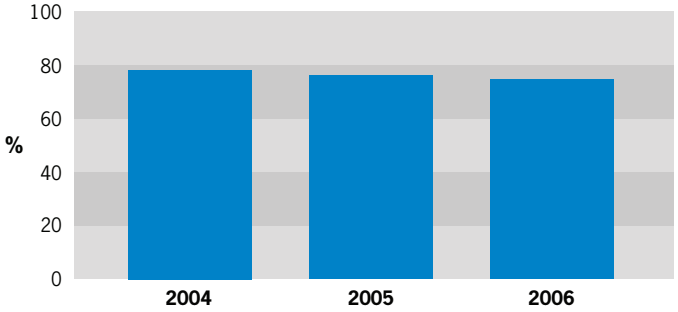
Hemispherectomy

Hemispherectomy is a specialized technique for treating medically intractable epilepsy arising from one side of the brain. This innovative approach developed at Cleveland Clinic has allowed for dramatic improvements in seizure freedom and improved outcomes for patients with epilepsy related to disorders such as hemimegalencephaly, Rasmussen's encephalitis, and malformation of cortical development.



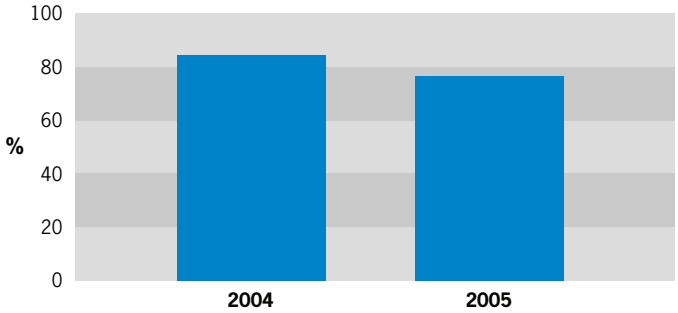
The volume of pediatric hemispherectomies has steadily increased as our team has gained surgical experience and expertise.

Pediatric Seizure Freedom at 6 Months

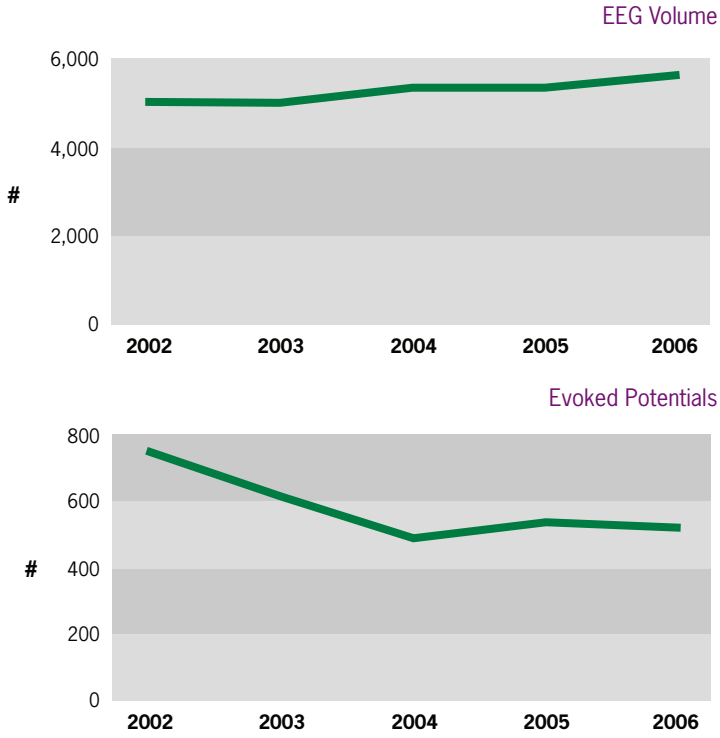


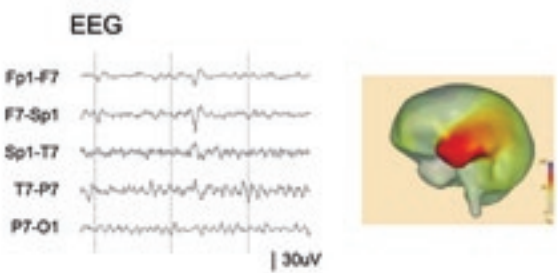
Children undergoing craniotomy for hemispherectomy enjoy high rates of seizure freedom at six months and one year after surgery.

Pediatric Seizure Freedom at 1 Year



Outpatient Epilepsy Testing

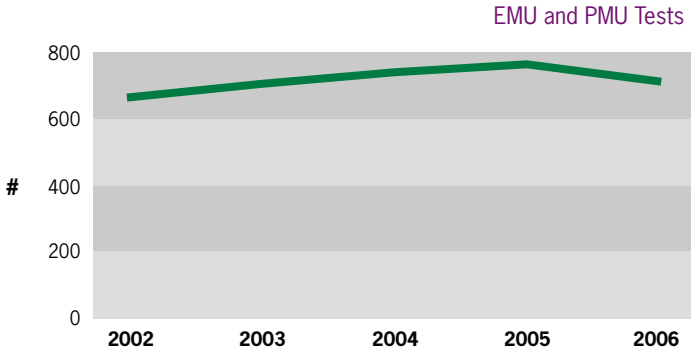




A three-second EEG epoch analyzed to estimate the location of the source of this left anterior temporal spike. The minimum norm current density image shows the distribution of the current dipole amplitude at the time of spike peak, projected onto the surface of the standard brain model.

Epilepsy Monitoring Units

Our team also evaluates more than 900 patients per year in our 10-bed Adult Epilepsy Monitoring Unit (EMU) and Pediatric Monitoring Unit (PMU). A newly remodeled and expanded PMU will open in 2007.

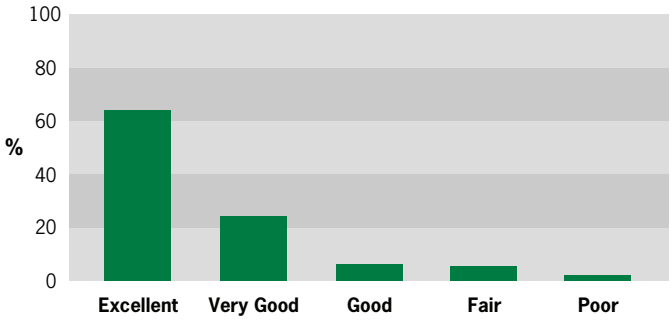


Located at Cleveland Clinic's main campus, these units feature state-of-the-art, all-digital video EEG equipment. They operate 24 hours a day, seven days a week, staffed by nurses and EEG technicians who specialize in epilepsy.

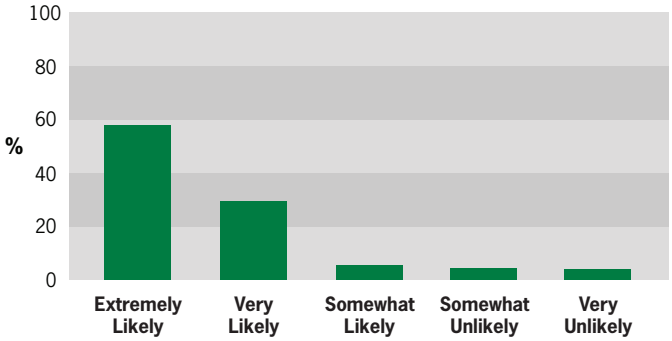
Epilepsy Center
Patient Experience

We ask our patients about their experiences and satisfaction with the services provided by our staff. Although our patients are already indicating we provide excellent care, we are committed to continuous improvement.

Outpatient
Overall Rating of Care



Outpatient
Would Recommend Provider



Epilepsy Center | Innovations

- Creation of a multidisciplinary/comprehensive cognitive and behavioral program to provide psychosocial assistance to patients with seizures at various stages of evaluation and treatment, bringing together epileptologists, psychiatrists, psychologists, social workers and rehabilitation specialists.
- Introduction of state-of-the-art seizure detection and electrical stimulation techniques for the treatment of drug-resistant focal epilepsies difficult to treat surgically.
- Testing of molecular imaging techniques for the accurate, noninvasive localization of epileptic areas in the brain.
- Establishment of a comprehensive program to study outcome measures in patients undergoing surgical treatment at the Cleveland Clinic Epilepsy Center.
- Creation of a multidisciplinary tuberous sclerosis program to manage neurological, epileptic, cardiac, renal and genetic aspects of tuberous sclerosis complex.

Epilepsy Center
New Knowledge

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Alexopoulos A, Lachhwani DK, Gupta A, Kotagal P, Harrison AM, Bingaman W, Wyllie E. Resective surgery to treat refractory status epilepticus in children with focal epileptogenesis. *Neurology* 2005;64:567-570.

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Díez-Sampedro A, Silverman WR, Bautista JF, Richerson GB. Mechanism of increased open probability by a mutation of the BK channel. *J Neurophysiol* 2006; 96:1507-1516.

Du W, Bautista JF, Yang H, Diez-Sampedro A, You S-A, Wang L, Kotagal P, Lüders HO, Shi J, Cui J, Richerson GB, Wang Q. Calcium-sensitive potassium channelopathy in human epilepsy and paroxysmal movement disorder. *Nat Genet* 2005;37:733-738.

Hiremath GK, Kotagal P, Bingaman W, Hovinga C, Wyllie E, Morris H, Nelson D. Risk factors for carbamazepine elevation following epilepsy surgery. *Seizure* 2005;14:312-317.

Jeha LE, Najm IM, Bingaman WE, Khandwala F, Widdess-Walsh P, Morris HH, Dinner DS, Nair D, Foldvary-Schaeffer N, Prayson RA, Comair Y, O'Brien R, Bulacio J, Gupta A, Lüders HO. Predictors of outcome after temporal lobectomy for the treatment of intractable epilepsy. *Neurology* 2006;27;66:1938-1940.

Widdess-Walsh P, Diehl B, Najm I. Neuroimaging of focal cortical dysplasia. *J Neuroimaging* 2006;16:185-196.

Ying Z, Tilelli C, Gonzalez-Martinez J, Bingaman W, Najm I. Expression of Neural stem cell surface marker CD133 in balloon cells of human focal cortical dysplasia. *Epilepsia* 2005;46:1716-1723.

Epilepsy Center | Director
Staff Listing

Imad Najm, M.D.
Director, Epilepsy Center

Staff Listing

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Jocelyn Bautista, M.D.
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Robyn Busch, Ph.D.
Beate Diehl, M.D.
Tatiana Falcone, M.D.
Nancy Foldvary-Schaefer, D.O.
Ajay Gupta, M.D.
Jennifer Haut, Ph.D.
Lara Jehi, M.D.
Patricia Klaas, Ph.D.
Prakash Kotagal, M.D.
Deepak Lachhwani, M.D.
Dileep Nair, M.D.
Richard Naugle, Ph.D.
Paul Ruggieri, M.D.
George Tesar, M.D.
Ingrid Tuxhorn, M.D.
Elaine Wyllie, M.D.

Headache Center

Director's Letter

We are pleased to provide the 2006 outcomes report for the Cleveland Clinic Headache Center.

Midway through 2006, the Headache Center was integrated into the newly formed Neurological Institute. We believe this setting will foster an active and ongoing interchange of expert professional opinions, all under the umbrella of one, fully integrated institute. This innovative structure will benefit our patients by enhancing the multidisciplinary diagnosis and treatment of headache.

Measuring outcomes in headache treatment is a difficult task, in part because of the subjective nature of headache pain; however, we believe the continuing growth in our patient volume is an indirect measure of the success of our program – when patients report to their primary physician, family or friends that treatment received here has reduced the severity or frequency of their headaches, it leads to more referrals.

The following pages provide a snapshot of the Headache Center and our interdisciplinary approach to diagnosing and managing headache disorders. We hope you find it interesting and useful. As always, we welcome your referrals.

Mark Stillman, M.D.
Director, Headache Center

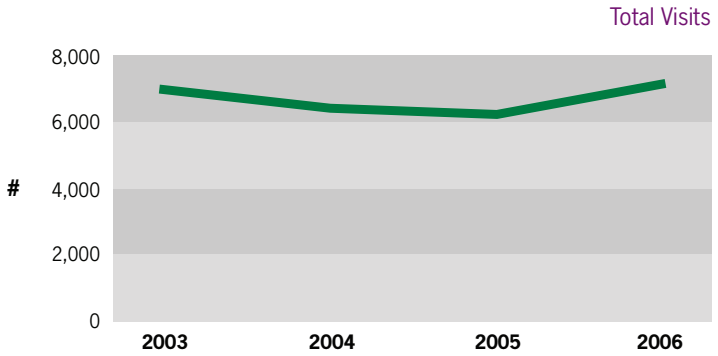
Headache Center

Center Overview

- Dedicated to diagnosis and management of headache disorders, facial pain syndromes and associated disorders.
- Primary headaches treated include migraine with and without aura, tension headache and cluster headache.
- Secondary headaches treated include sinus headaches, hormonal headaches and chronic progressive headaches.
- More than 7,000 patient visits in 2006 compared with 6,200 in 2005: approximately 2,000 for headache, 2,400 for migraine and 500 for spasmodic torticollis.
- In the forefront using Botox in headache treatment: 781 patients in 2006, a significant increase from 569 patients in 2005.
- Emergency infusion service provided urgent care for headache crisis for 1,600 patients in 2006, up from 1,500 in 2005.

Headache Center
Quality & Outcomes Measures

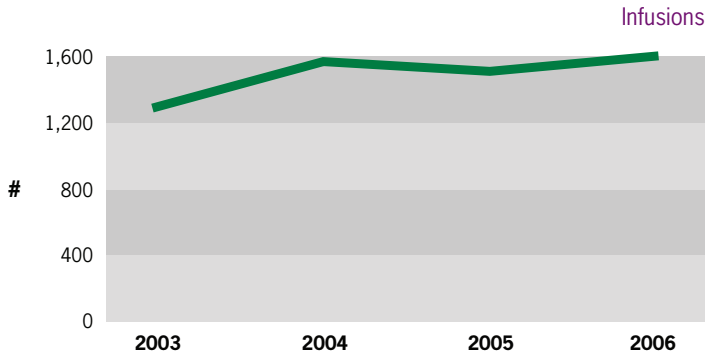
The Headache Center is primarily an outpatient practice. Total patient visits reached more than 7,000 in 2006.



The number of patients treated with Botox increased nearly 40% in 2006.

The infusion suite provides intravenous treatments specifically for headaches under the guidance of a headache staff physician. Same-day care is also available for patients in the Headache Program. Hours are Monday through Friday, 8 a.m. to 4:30 p.m.

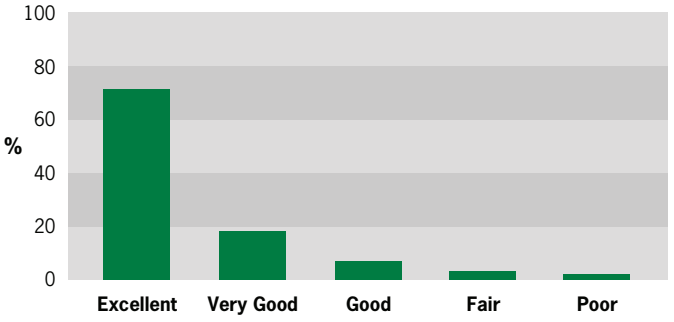
The volume of patients using this emergency service continued to grow in 2006, and the capacity was expanded to 10 beds.



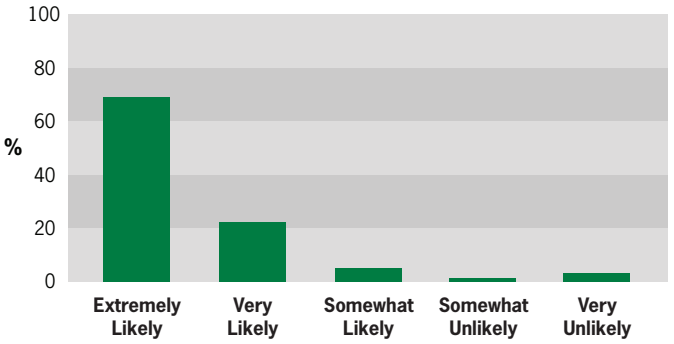
Headache Center
Patient Experience

We ask our patients about their experiences and satisfaction with the services provided by our staff. Although our patients are already indicating we provide excellent care, we are committed to continuous improvement.

Outpatient
Overall Rating of Care



Outpatient
Would Recommend Provider



Headache Center

Innovations

- Expansion and remodeling of the emergency infusion service to 10 beds.
- Certification of the Cleveland Clinic Headache Fellowship by the Unified Council of Neurological Subspecialties.

Headache Center
New Knowledge

Guyuron B, Kriegler J, Amini SB, Davis J. Comprehensive surgical treatment of migraine headaches. *Plast Resconstr Surg* 2005;115:1-9.

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Stillman M. Testosterone replacement therapy for treatment refractory cluster headache. *Headache* 2006;46:925-933.

Headache Center | Director
Staff Listing

Mark Stillman, M.D.
Director, Headache Center

Staff
Cynthia Bamford, M.D.
Neil Cherian, M.D.
Thomas Gretter, M.D.
Steven Krause, Ph.D.
Jennifer Kriegler, M.D.
Robert Kunkel, M.D.
MaryAnn Mays, M.D.
Stephen Samples, M.D.
Roderick Spears, M.D.

Mellen Center for Multiple Sclerosis Treatment and Research

Director's Letter

The Edward J. and Louise E. Mellen Center for Multiple Sclerosis Treatment and Research is pleased to present our 2006 outcomes report. In addition to providing data related to our clinical activity, this report also offers an overview of the Mellen Center, a listing of selected scientific papers published by our staff in 2006 and a summary of patient experience here.

As the world's largest and most comprehensive program for multiple sclerosis care and research, the Mellen Center is at the forefront of progress in the diagnosis and management of this disease. The total number of patient visits continues to increase, growing to more than 20,000 in 2006. This volume serves as a constant reminder of our commitment to providing optimal, individualized care for our patients. By continuously monitoring our performance, we are driven to maintain the highest standards of clinical care.

We believe that it is important to share outcomes information with our referring physicians, patients, alumni and others interested in our multiple sclerosis program. We hope that you find this data helpful and informative.

Richard Rudick, M.D.
Director, Mellen Center for Multiple Sclerosis Treatment and Research

Mellen Center for Multiple Sclerosis Treatment and Research

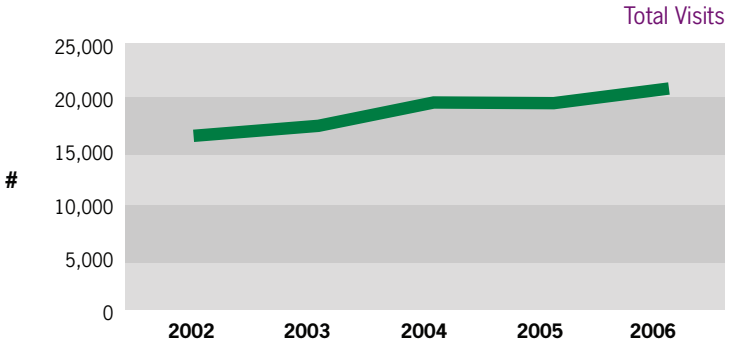
Center Overview

- Established in 1984, now one of the largest and most comprehensive programs for multiple sclerosis (MS) care and research worldwide.
- Addresses physical, emotional, cognitive and rehabilitation needs of the MS patient and their family members through a team approach.
- Mellen Center physicians are national leaders in basic and clinical research related to MS pathogenesis and medical management and have made major contributions in the development of drugs to control MS disease activity and progression.
- Mellen Center physicians provide consultative services for neurologists and patients world-wide and ongoing care for approximately 8,000 MS patients annually, including approximately 1,600 new patient/consult visits.
- Program highlights include neurorehabilitation, imaging, therapeutics and clinical research.
- Integration of neurorehabilitation with spasticity management through the use of baclofen pumps and Botox injections.
- Implanted 42 baclofen pumps in 2006, a 30% increase over 2005.
- Standard and investigational imaging provided through standard and high field strength MRI equipment staffed by an expert team.
- Latest pharmaceutical therapies delivered in the setting of a new, 15-chair infusion center.
- Significant clinical research opportunities available for Mellen Center patients, ranging from genetic studies through trials of new treatments.
- Funded research for basic and clinical science totaled $6,129,031 at the Mellen Center in 2006, representing a large research program in experimental therapeutics, neuroimaging, neurorehabilitation, neurobiology and immunology and leading to 79 published articles or chapters by Mellen Center physicians and researchers.

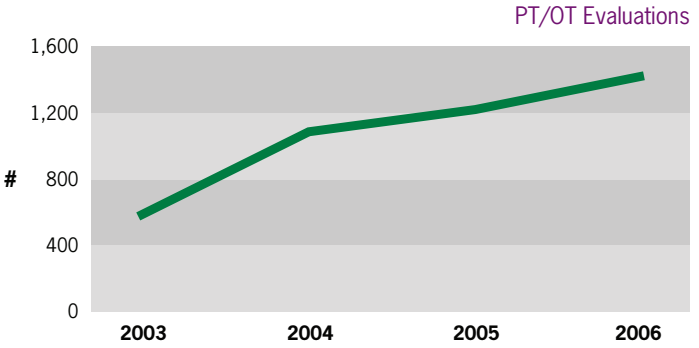
Mellen Center for Multiple Sclerosis Treatment and Research

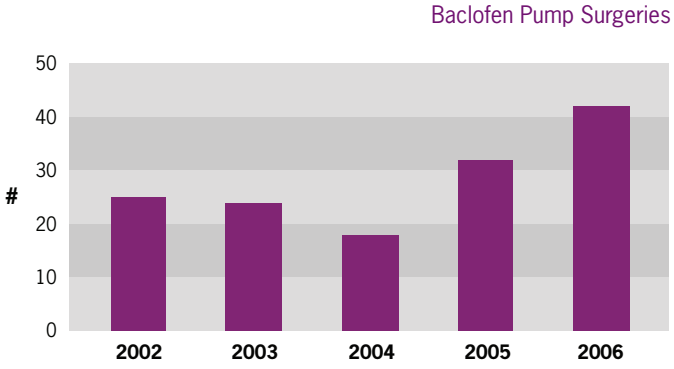
Quality & Outcome Measures

The Mellen Center team of clinical providers completed just over 20,000 patient visits in 2006 in the outpatient setting. These visits included infusion treatments, health psychology, neuropsychology and OT and PT services in addition to clinical management by physicians and nurses. Approximately 1,600 of the visits were new/consult visits.



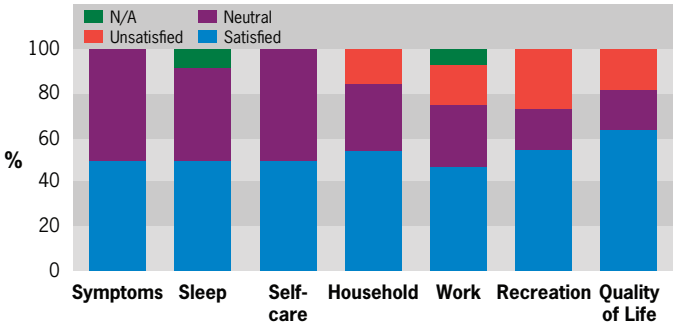
One unique and expanding service the Mellen Center offers is neurorehabilitation, which consists of consultation with our team physiatrist and evaluations by occupational and physical therapy. The graph below depicts the rapid growth in the OT and PT evaluations in recent history.





The Mellen Center is the leading MS center in the utilization and assessment of baclofen pumps to assist in the management of spasticity in both ambulatory and non-ambulatory MS. In 2006, we experienced a 30% increase in baclofen pump surgeries compared to 2005. In addition, we offered specialized training to the staff of five other MS centers on the management program for the pumps.

Patient Satisfaction at Month Six



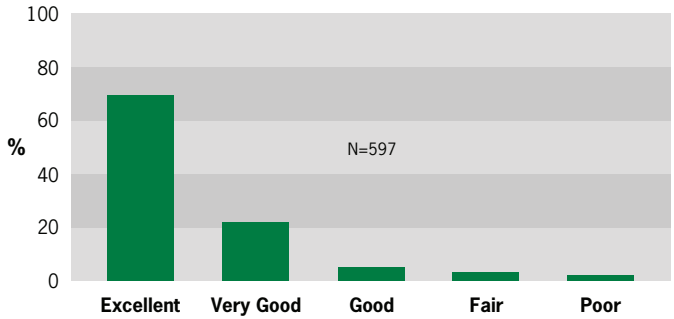
Patient satisfaction with the outcomes and effectiveness of baclofen pump is systematically assessed at six-month intervals. Between months one and six, patient satisfaction with regard to their ability to perform household work and recreation activities increased. Satisfaction with symptom control, sleep and ability to perform self-care decreased in the same time period. Overall, satisfaction with quality of life remained constant in the first six months.

Mellen Center for Multiple Sclerosis Treatment and Research

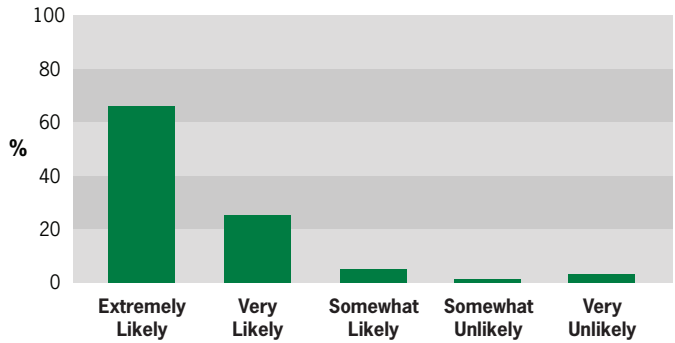
Patient Experience

We ask our patients about their experiences and satisfaction with the services provided by our staff. Although our patients are already indicating we provide excellent care, we are committed to continuous improvement.

Outpatient
Overall Rating of Care



Outpatient
Would Recommend Provider



Mellen Center for Multiple Sclerosis Treatment and Research | Innovations

- Publication of first definitive study comparing active treatment arms (standard therapy vs. combination therapy) in the MS field, showing that the combination of interferon beta-1a with natalizumab was significantly more efficacious than treatment with interferon beta-1a alone.
- Mellen Center staff led, designed and conducted clinical trials of natalizumab (Tysabri), the first disease-modifying agent approved for MS in the past 10 years, which the FDA approved in 2006. Due to the risk of certain serious adverse effects, Tysabri is being used cautiously in certified infusion centers, such as the Mellen Center.
- Completed the first investigator-initiated study of interferon beta-1a in combination with common, inexpensive medications (corticosteroids or methotrexate) with results presented at the American Academy of Neurology Meeting in April 2007.
- Richard Ransohoff, M.D., was among 55 physicians nationally to be elected to the prestigious Association of American Physicians, becoming the 12th neurologist admitted to AAP.
- Richard Rudick, M.D., was elected as a Fellow of the American Association for Advancement of Science, one of 40 fellows inducted nationally in the category of medical sciences in 2006.
- Discovery by Richard Ransohoff, M.D., that microglia, the resident inflammatory cells of the brain, are the only CNS cells that express the fractalkine receptor (CX3CR1).

Mellen Center for Multiple Sclerosis Treatment and Research | New Knowledge

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Fox RJ, Mahad D, Callahan MK, Williams KA, Ubogu EE, Kivisäkk P, Tucky B, Kidd G, Kingsbury GA, Chang A, Mack M, Sniderman MB, Ravid R, Staugaitis SM, Stins MF, Ransohoff RM. Modulating CCR2 and CCL2 at the blood-brain barrier: relevance for multiple sclerosis pathogenesis. *Brain* 2006;129:212-223.

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Mellen Center for Multiple Sclerosis Treatment and Research | Director

Staff Listing

Richard Rudick, M.D.
Director, Mellen Center for Multiple Sclerosis Treatment and Research

Staff

Francois A. Bethoux, M.D.
Jeffrey Cohen, M.D.
Peggy Crawford, Ph.D.
Robert J. Fox, M.D.
Medical Director, Mellen Center for Multiple Sclerosis Treatment and Research
Keith McKee, M.D.
Ruth Ann Marrie, M.D.
Deborah Miller, Ph.D.
Richard Ransohoff, M.D.
Mary Rensel, M.D.
Lael A. Stone, M.D.

Neuromuscular Center
Director's Letter

The Cleveland Clinic Department of Neurology has a long and respected tradition of diagnosing and managing nerve and muscle diseases such as amyotrophic lateral sclerosis (ALS), peripheral neuropathy, myasthenia gravis and myopathies. The Cleveland Clinic Neuromuscular Center was created in 2006 within the new Cleveland Clinic Neurological Institute to facilitate multidisciplinary referral, treatment and consultation for patients with these complex diseases. We believe this reorganization will enhance patient care and lead to fresh opportunities in the realms of education and research while maintaining our legacy of excellence.

Much of our practice continues to be focused on outpatient care, helping patients and their families manage their disease and maximize their quality of life. The reputation of our physicians attracts patients from all over the world who come here for comprehensive assessment and innovative solutions to difficult problems.

The following pages illustrate the Neuromuscular Center's achievements over the past year. This information not only provides an overview of the Neuromuscular Center's clinical activity but also highlights our academic accomplishments and innovative research.

We are pleased to share our data with colleagues, referring physicians, patients, alumni and donors and hope you will find it useful and informative.

Kerry Levin, M.D.
Director, Neuromuscular Center

Neuromuscular Center

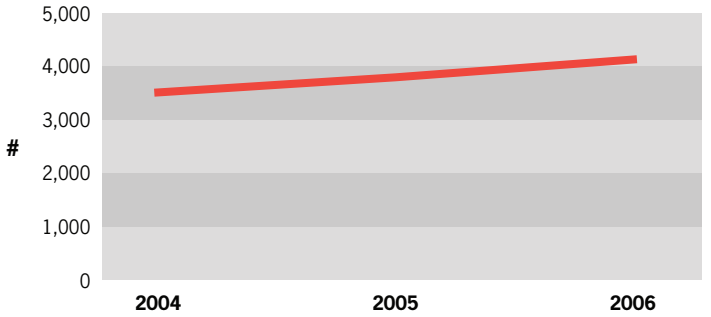
Center Overview

- Specializes in the diagnosis and treatment of nerve and muscle disorders such as amyotrophic lateral sclerosis (ALS), peripheral neuropathy, peripheral nerve injury, myasthenia gravis and myopathies.
- Interdisciplinary team of specialists works together to minimize disability and maximize quality of life for patients affected with these disorders.
- More than 4,100 outpatient visits in 2006.
- One of the largest electromyography (EMG) laboratories in the state of Ohio, performing more than 3,400 EMGs in 2006, including the highly specialized single-fiber EMG.
- Autonomic laboratory diagnostic capabilities include cardiovascular autonomic testing with tilt, QSART, QST, SSRT and infrared pupillometry testing.
- Other diagnostic testing available:
    - Electrodiagnostic examination
    - Muscle and nerve biopsies
    - Skin biopsies
    - Spinal fluid analysis
- Emphasis on a multidisciplinary approach to treatment of neuromuscular disorders: the use of appropriate medications and intravenous immunoglobulin (IVIG), therapeutic apheresis and ancillary services such as physical and occupational therapy, speech therapy and pain management.
- Amyotrophic Lateral Sclerosis (ALS) Center is one of 14 centers in the United States designated by the Amyotrophic Lateral Sclerosis Association, a group of specialists who care for more than 200 ALS patients a year.
- Offers a peripheral nerve specialty clinic in collaboration with the Department of Neurosurgery for peripheral nerve injuries, tumors or focal neuropathies.

Neuromuscular Center
Quality & Outcome Measures

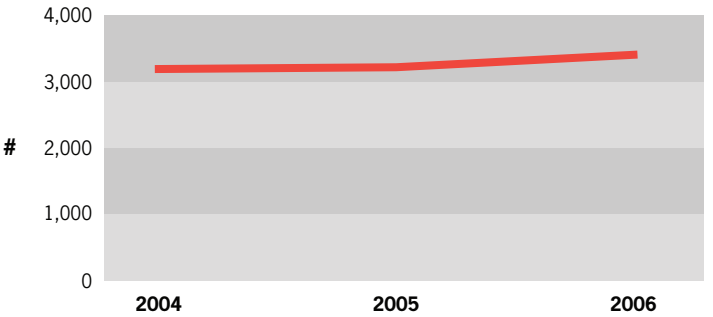
The Neuromuscular Center is primarily an outpatient practice. Patient volume continued to grow in 2006, reaching more than 4,100 clinic visits.

Clinic Visits

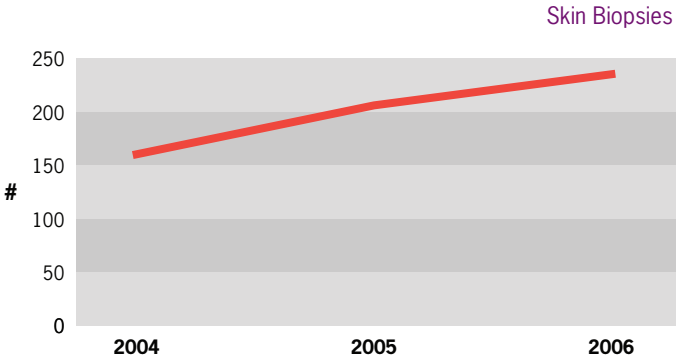


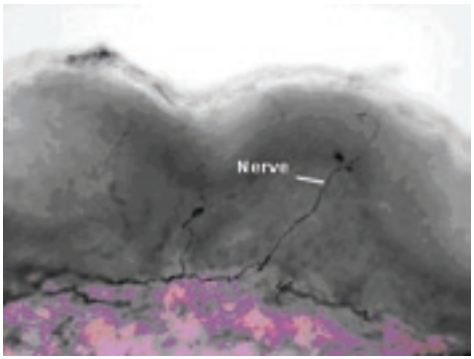
The Neuromuscular Center's EMG laboratory is one of the largest in the state of Ohio and has a worldwide reputation for excellence and reliability. Nearly 3,400 EMGs were performed in 2006.

EMG Volume



Cleveland Clinic neuromuscular disease specialists have offered muscle, nerve and skin biopsies since 2004. Immunohistological staining of the tissue sample allows for identification of the underlying type and cause of myopathies and neuropathies. Over the past two years, the volume of this specialized and highly informative test has increased significantly.



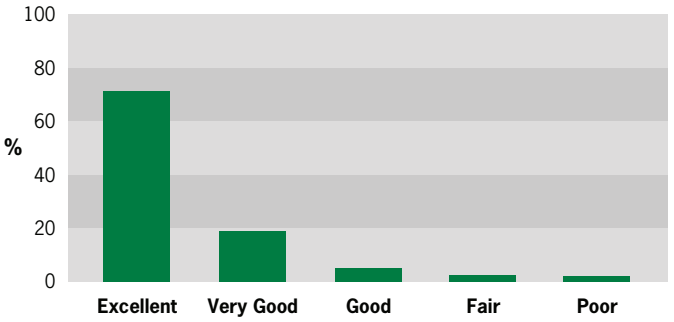


Skin biopsy stain

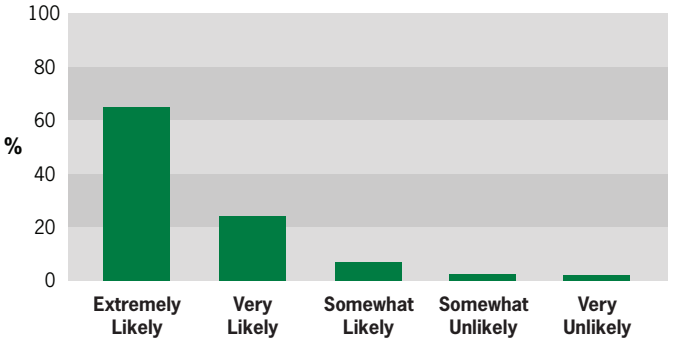
Neuromuscular Center
Patient Experience

We ask our patients about their experiences and satisfaction with the services provided by our staff. Although our patients are already indicating we provide excellent care, we are committed to continuous improvement.

Outpatient
Overall Rating of Care



Outpatient
Would Recommend Provider



Neuromuscular Center
Innovations

- NIH grant awarded to Lan Zhou, M.D., to study inflammation in muscular dystrophy. The research is aimed at identifying modifying factors that can decrease the disabling effects of inflammation and fibrosis in the production of progressive disability in a rodent model of Duchenne dystrophy.
- Research by Erik Pioro, M.D., Ph.D., to analyze the effects of certain inflammatory cells in the central nervous system in an experimental model of amyotrophic lateral sclerosis (ALS).
- Research by Erik Pioro, M.D., Ph.D., to assess the value of central nervous system growth factors as a treatment for patients with ALS.
- Establishment of a skin biopsy histopathology lab and skin biopsy service to search for the presence of nerve damage in the skin of patients with small fiber peripheral neuropathies.

Neuromuscular Center
New Knowledge

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Levin KH. Motor nerve conduction studies. In: Kimura J, ed. Clinical Neurophysiology of Peripheral Nerve Diseases, Handbook of Clinical Neurophysiology, Volume 7. Edinburgh: Elsevier; 2006:139-154.

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Neuromuscular Center | Director
Staff Listing

Kerry Levin, M.D.
Director, Neuromuscular Center

Staff
Kamal Chemali, M.D.
Rebecca Kuenzler, M.D.
Erik Pioro, M.D., Ph.D.
David Polston, M.D.
Robert Shields, Jr., M.D.
Patrick Sweeney, M.D.
Deborah A. Venesy, M.D.
Lan Zhou, M.D.

Sleep Disorders Center
Director's Letter

I am pleased to present the 2006 quality and outcome measures for the Cleveland Clinic Sleep Disorders Center. Midway through 2006, the reorganization of the neurosciences departments at Cleveland Clinic led to the establishment of the Sleep Disorders Center as an independent entity within the newly created Neurological Institute.

Under this arrangement, we continue to offer a comprehensive program dedicated to the diagnosis and treatment of sleep and wake disorders. Based in the Fairhill Medical Building, 1.3 miles from Cleveland Clinic main campus, our state-of-the-art facility is accredited as a full-service center by the American Academy of Sleep Medicine.

Additionally, we offer hotel settings for sleep testing, an option that contributed significantly to increased patient volume in 2006. This strategy, introduced in 2005, has been well received by patients and, we believe, encourages more patients to seek help for sleep problems.

According to the National Sleep Foundation, one in three Americans experiences daytime sleepiness that interferes with daily activities on a regular basis. Our dedicated physicians continue to seek answers to the causes of sleep disorders, improve diagnostic techniques and advance the treatment of these often complex problems in people of all ages. Some of our most significant research published in 2006 is highlighted in the following pages.

As always, we welcome your referrals and look forward to working with you.

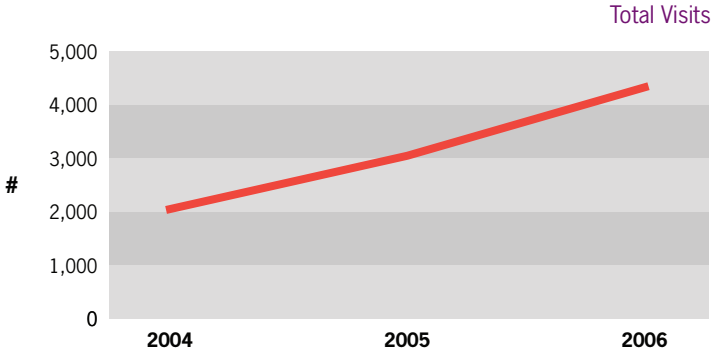
Nancy Foldvary-Schaefer, D.O.
Director, Sleep Disorders Center

Sleep Disorders Center

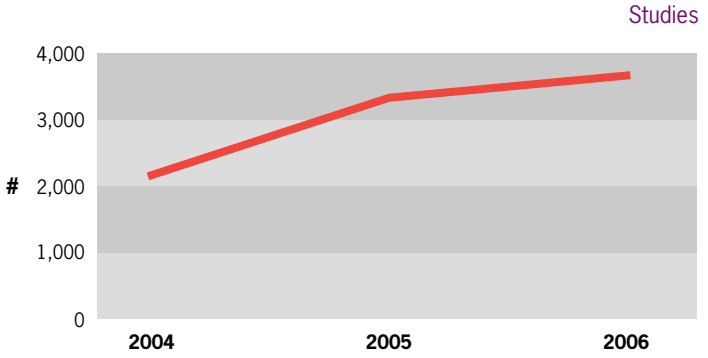
Center Overview

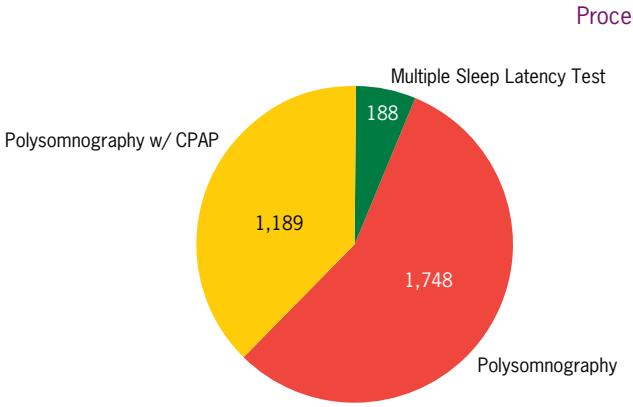
- Established in 1978; among the first centers in the nation dedicated to the diagnosis and treatment of sleep disorders in people of all ages: insomnia, sleep apnea, narcolepsy, restless leg syndrome and sleep problems related to psychiatric/psychological illness.
- Accredited by the American Academy of Sleep Medicine.
- Staffed by physicians specializing in sleep disorders from a variety of disciplines: adult and child neurology, pulmonary and critical care medicine, psychology, psychiatry, otolaryngology and dentistry.
- Total patient visits reached 4,300 in 2006.
- More than 3,600 sleep studies were performed in our laboratory in 2006.
- Diagnostic testing includes polysomnography, multiple sleep latency testing for narcolepsy, video monitoring, esophageal pressure monitoring, carbon dioxide monitoring for pulmonary disorders and penile tumescence for the evaluation of impotence and sleep apnea.

Sleep Disorders Center
Quality & Outcome Measures

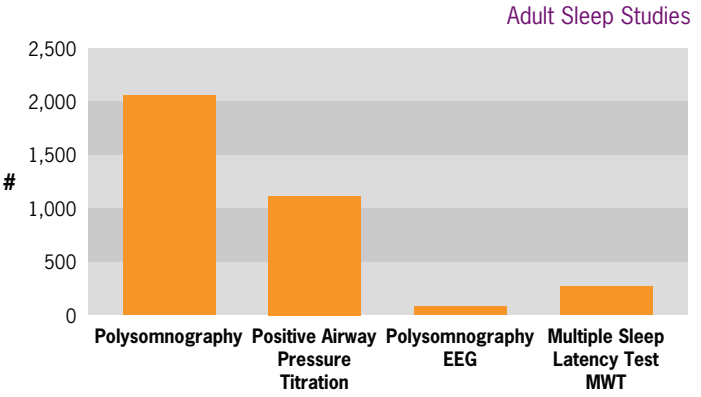


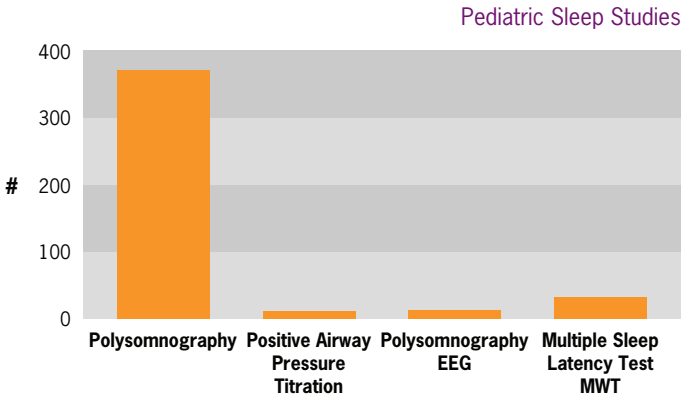
Since expanding services into multiple hotel settings in 2005, the volume of sleep studies performed annually continued to grow. Patients find the hotel setting offers a comfortable option for undergoing a sleep study.



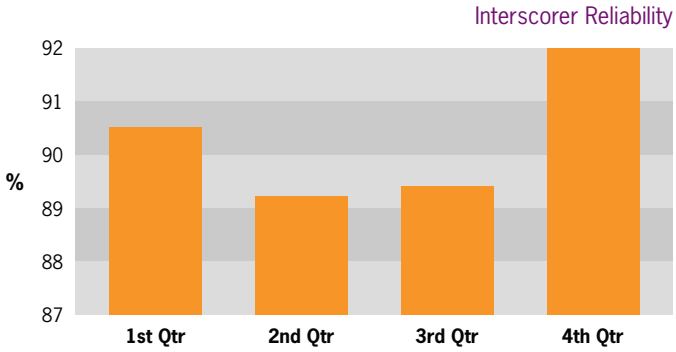


The Sleep Disorders Center Quality Assurance Program tracks seven quality indicators each quarter for each of its accredited sleep laboratories. Out of 3,921 overnight studies performed in 2006, only one sentinel event occurred, related to comorbid cardiovascular disease. All sleep technologists are BLS-certified and trained in the Center's medical emergency plans.





Assuring appropriate follow-up and treatment after sleep testing is one of the Center's quality indicators. In 2006, 98% of patients who underwent sleep testing treated by our sleep experts had appropriate follow-up and treatment of their problem.

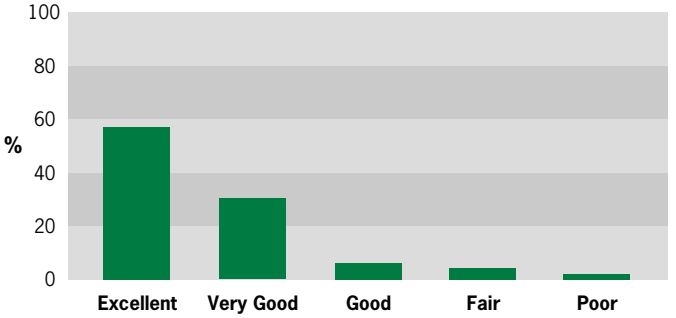


Sleep study quality rests largely on the expertise of the recording and scoring technologists. Interscorer reliability is tracked each quarter for all technologists. The American Academy of Sleep Medicine requires technologists to achieve a score of at least 85% compared to the sleep staging and event scoring of a board-certified physician. For 2006, interscorer reliability significantly surpassed the national standard for all Cleveland Clinic Sleep Disorders Center locations.

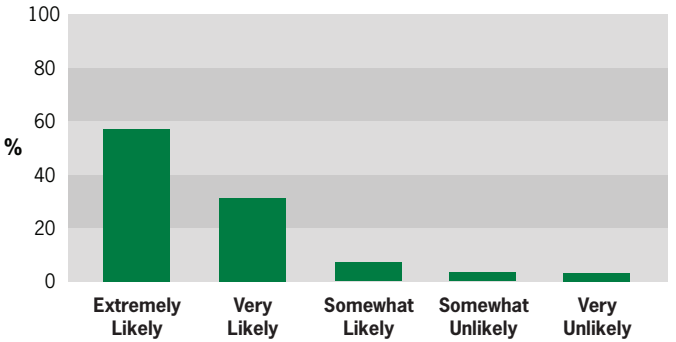
Sleep Disorders Center
Patient Experience

We ask our patients about their experiences and satisfaction with the services provided by our staff. Although our patients are already indicating we provide excellent care, we are committed to continuous improvement.

Outpatient
Overall Rating of Care



Outpatient
Would Recommend Provider



Sleep Disorders Center | Innovations

- Initiated use of hotel-based sleep laboratories for diagnostic sleep monitoring.
- Publication: Getting a Good Night's Sleep: A Cleveland Clinic Guide by Nancy Foldvary-Schaefer, D.O. Cleveland Clinic Press, 2006.

Sleep Disorders Center | New Knowledge

Bae CJ, Golish JG. The sleep interview and sleep questionnaires. In: Lee-Chiong TL, ed. Encyclopedia of Sleep Medicine. Hoboken, NJ: Wiley; 2006.

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Sleep Disorders Center | Director
Staff Listing

Nancy Foldvary-Schaefer, D.O.
Director, Sleep Disorders Center

Staff
Charles Bae, M.D.
Kumaraswamy Budur, M.D.
Joseph Golish, M.D.
Prakash Kotagal, M.D.
Carlos Rodriguez, M.D.
Roxanne Valentino, M.D.

Department Contacts | How to Refer Patients

For all patient referrals to the Neurological Institute, please call 866.588.2264.

Our Medical Concierge representatives facilitate appointments for patients from out of town. For more information, call 216.445.5580 or 800.223.2273, extension 55580.

For more information about the Cleveland Clinic Neurological Institute, visit www.clevelandclinic.org/neuroscience

Locations

The Cleveland Clinic Neurological Institute is a Cleveland Clinic-wide endeavor to provide world-class diagnosis and treatment to patients across Northeast Ohio. Institute physicians see patients at Cleveland Clinic main campus, six Neurological Institute Regional Centers and Cleveland Clinic Family Health Centers as listed below. Please inquire about availability of specific services at each location when calling. Visit us online at clevelandclinic.org/neuroscience.

Main Campus
9500 Euclid Avenue
Cleveland, OH 44195
866.588.2264

Neurological Institute
Regional Centers

Euclid Hospital
216.531.9000
Fairview Hospital
216.476.7000
Hillcrest Hospital
440.312.4500
Huron Hospital
216.761.3300
Lakewood Hospital
216.521.4200
Lutheran Hospital
216.696.4300

Cleveland Clinic Family
Health Centers

Beachwood
216.839.3000
Chagrin Falls
440.893.9393
Independence
216.986.4000
Lorain
440.204.7400
Solon
440.519.6800
Strongsville
440.878.2500
Westlake
440.899.5555
Willoughby Hills
440.943.2500
Wooster
330.287.4500

Cleveland Clinic Overview

Cleveland Clinic, founded in 1921, is a not-for-profit academic medical center that integrates clinical and hospital care with research and education. Today, 1,700 Cleveland Clinic physicians and scientists practice in 120 medical specialties and subspecialties.

Cleveland Clinic's main campus, with 41 buildings on 130 acres in Cleveland, Ohio, includes a 1,000-bed hospital, outpatient clinic, subspecialty centers and supporting labs and facilities. Cleveland Clinic also operates 13 family health centers, eight community hospitals, two affiliate hospitals, and a medical facility in Weston, Florida.

At the Cleveland Clinic Lerner Research Institute, hundreds of principal investigators, project scientists, research associates and postdoctoral fellows are involved in laboratory-based research. Total annual research expenditures exceed $150 million from federal agencies, non-federal societies and associations, and endowment funds. In an effort to bring research from bench to bedside, Cleveland Clinic physicians are involved in more than 2,400 clinical studies at any given time.

In September 2004, Cleveland Clinic Lerner College of Medicine of Case Western Reserve University opened and will graduate its first 32 students as physician-scientists in 2009.

For more details about Cleveland Clinic, visit clevelandclinic.org.

Online Services

eCleveland Clinic

eCleveland Clinic uses state-of-the-art digital information systems to offer several services, including remote second opinions through a secure Web site to patients around the world; personalized medical record access for patients; patient treatment progress access for referring physicians (see below); and imaging interpretations by the Department of eRadiology's subspecialty trained academic radiologists. For more information, please visit eclevelandclinic.org.

DrConnect

Online Access to Your Patient's Treatment Progress

Whether you are referring from near or far, our new eCleveland Clinic service, Dr**Connect**, can streamline communication from Cleveland Clinic physicians to your office. This new online tool offers you secure access to your patient's treatment progress at Cleveland Clinic. With one-click convenience, you can track your patient's care using the secure Dr**Connect** Web site. To establish a Dr**Connect** account, visit eclevelandclinic.org or e-mail drconnect@ccf.org.

MyConsult

My**Consult** Remote Second Medical Opinion is a secure, online service providing specialist consultations and remote second medical opinions for more than 600 life-threatening and life-altering diagnoses. My**Consult** remote second medical opinion service allows you to gather information from nationally recognized specialists without the time and expense of travel. For more information, visit eclevelandclinic.org/myconsult, e-mail eclevelandclinic@ccf.org or call 800.223.2273, ext 43223.

Cleveland Clinic Contact Numbers

How to Refer Patients
24/7 Hospital Transfers or Physician Consults
800.553.5056

General Information
216.444.2200

Hospital Patient Information
216.444.2000

Patient Appointments
216.444.2273 or 800.223.2273

Medical Concierge
Complimentary assistance for out-of-state patients and families
800.223.2273, ext. 55580, or email: medicalconcierge@ccf.org

International Center
Complimentary assistance for international patients and families
216.444.6404 or visit www.clevelandclinic.org/ic

Cleveland Clinic in Florida
866.293.7866

www.clevelandclinic.org

Cleveland Clinic is determined to exceed the expectations of patients, families and referring physicians. In light of this goal, we are committed to providing accurate and timely information about our patient care. Through participation in national initiatives, we support transparent public reporting of healthcare quality data and participate in the following public reporting initiatives:

- Joint Commission Performance Measurement Initiative (www.qualitycheck.org)
- Centers for Medicare and Medicaid (CMS) Hospital Compare (www.hospitalcompare.hhs.gov)
- Leapfrog Group (www.leapfroggroup.org)
- Ohio Department of Health Service Reporting (www.odh.state.oh.us)

In addition, this publication was produced to assist patients and referring physicians in making informed decisions. To that end, information about care and services is provided, with a focus on outcomes of care. For more information, please visit the Cleveland Clinic Quality Web site at clevelandclinic.org/quality.

9500 Euclid Avenue, Cleveland, OH 44195

Cleveland Clinic is a not-for-profit multispecialty academic medical center. Founded in 1921, it is dedicated to providing quality specialized care and includes an outpatient clinic, a hospital with more than 1,000 staffed beds, an education division and a research institute.