Craniectomy may have some utility as a component of removal of hemorrhagic mass lesions in management of traumatic brain injury.

**Background:** Craniectomy in severe traumatic brain injury (TBI) may be performed to manage intractable elevated intracranial pressure (ICP) or to avoid postoperative development of elevated ICP following craniotomy for a hemorrhagic mass lesion.

**Objective:** To clarify the role of craniectomy performed during removal of hemorrhagic mass lesions in TBI.

**Design:** Single-institution retrospective medical record review.

**Participants/Methods:** Patients with TBI from January 1, 2000, to June 30, 2006, treated with craniotomy alone were compared to those treated with craniectomy to prevent postoperative ICP elevation using data from Scripps Mercy Hospital Trauma Registry. Reasons for craniectomy were ascertained from operative reports. Patients with decompressive craniectomy for refractory ICP were excluded. Propensity score analysis was adjusted for selection biases in evaluating effects of craniectomy on survival.

**Results:** 135 patients (68.5%) had craniotomy and 62 (31.5%) had craniectomy to manage TBI. Craniectomy patients were significantly younger than craniotomy patients (41.5 vs 51.1 years) and had lower admission Glasgow Coma Scale (GCS) scores (mean, 7.6 vs 11.8). Craniotomy injury mechanisms of falls were more prevalent than were craniectomy mechanisms (55.6% vs 32.3%), but pedestrian versus auto mechanisms were less prevalent (5.2% vs 19.4%, respectively). Epidural hematomas were more common in craniotomy patients (19.3% vs 3.2%). Progressive injury on preoperative CT occurred more commonly in craniectomy (29% vs 11.1%). Preoperative ICP monitoring was more common in craniectomy (17.7% vs 5.2%) and more frequently >20 mm Hg or labile (100.0% vs 57.1%). Postoperative ICP monitoring was more common in craniectomy (77.4% vs 32.6%) and more frequently (not significantly) >20 mm Hg or labile (45.8% vs 29.5%). Craniectomy was performed sooner after admission (7.8 vs 27.1 hours). Craniectomy was performed for excessive brain swelling (67.7%) and young patient age (14.5%). Mortality was higher after craniectomy (41.9% vs 23.0%); propensity score analysis controlling for GCS motor score, age, and Abbreviated Injury Score showed equivalent mortality (craniectomy 41%, craniotomy 43%). Craniectomy utilization by individual neurosurgeons ranged from 8.6% to 75.0%.

**Conclusions:** When controlled for other variables, craniectomy is not associated with increased mortality compared to craniotomy alone.

**Reviewer's Comments:** The authors attempt to show that craniectomy performed with surgery for hemorrhage intracranial mass lesions in TBI can preempt postoperative elevated ICP. Unfortunately, the study has too many faults to be convincing. Craniectomy patients are different than craniotomy patients: different mechanisms of injury, lower presenting GCS, fewer epidural hematomas, younger age, and earlier operative intervention, among others. ICP monitoring was inconsistent, and its indications were not specified. Craniectomy was used for cerebral edema in only 67% of cases, and use appeared to be surgeon-specific. Use of craniectomy in cases other than those in which malignant cerebral edema precludes replacement of the bone flap is not more clearly defined by this study. (Reviewer-N. Scott Litofsky, MD).
Reperfusion Increases Survival Chances After Basilar Artery Occlusion

Multimodal Reperfusion Therapy in Patients With Acute Basilar Artery Occlusion.
Raphaeli G, Eichel R, et al:
Neurosurgery 2009; 65 (September): 548-552

Multimodal reperfusion therapy significantly increases the chances of survival and good outcome in patients presenting with acute basilar artery occlusion.

**Background:** Acute basilar artery occlusion has a very high mortality rate, up to 90%, when treated conservatively. Use of IV tissue plasminogen activator (tPA) can significantly improve outcome, but mortality remains high, and the time window for treatment is narrow. Intra-arterial use of thrombolysis further improves outcome, but results are not optimal. Multimodal therapy has been used with success for anterior circulation acute stroke.

**Objective:** To define any combination of ≥2 of the following therapeutic options as multimodal reperfusion therapy: intra-arterial lytics, angioplasty, stenting, intra-arterial glycoprotein IIb/IIIa antagonists, mechanical clot disruption, and use of clot-retrieving devices. In this study, the authors applied multimodal reperfusion therapy to patients presenting with acute basilar artery occlusion.

**Participants/Methods:** Consecutive patients treated with multimodal therapy over a 4-year period were analyzed retrospectively. Clinical findings were used to establish diagnosis of acute basilar artery occlusion, which was confirmed with digital subtraction angiography. Clinical and imaging features were analyzed.

**Results:** 24 patients were analyzed; 83% had a good reperfusion, defined as a score of 2 or 3 in the TIMI scale. The remaining 17% had poor or no reperfusion, defined as a TIMI score of 0 or 1. At 30 days post-stroke, 44% of 18 patients who survived had a good outcome, which was defined as a modified Rankin Scale (mRS) score of ≤3. At 90 days post-stroke, 12 patients had survived, 50% of whom had mRS scores of <2. The only pretreatment factor associated with an increased likelihood of survival and good outcome was presence of significant collateral circulation.

**Conclusions:** Reperfusion increases the chances of good outcome and decreases mortality. Therefore, the authors recommend that all acute basilar artery occlusions be treated with multimodal reperfusion therapy.

**Reviewer's Comments:** Acute basilar artery occlusion is associated with dismal outcomes. Our ability to reestablish flow in this situation has dramatically improved over the past 5 years, primarily owing to better embolectomy devices. As the authors indicate, it often takes >1 tool to get the job done. Getting the artery open safely and expeditiously, however, is more important than which tool is used. The results presented in this article reinforce our institutional view, and my personal belief, that aggressive attempts to recanalize an acutely occluded basilar artery could be the only hope for meaningful survival in these patients. (Reviewer-Bernard R. Bendok, MD).

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**Keywords:** Basilar Artery Occlusion, Endovascular, Multimodal, Reperfusion

**Print Tag:** Refer to original journal article
Microscope-integrated indocyanine green fluorescence angiography can be used as a complementary tool to digital subtraction angiography during cerebral arteriovenous malformation surgery.

Background: Invasive cerebral angiography can play a role during microsurgery for cerebral arteriovenous malformations (AVMs), but this technique has obvious limitations, including the need to temporarily remove the microscope from the operative field. Indocyanine green (ICG) angiography has recently emerged as an alternative to invasive angiography during microsurgery for cranial vascular pathologies.

Objective: To report the authors’ experience using ICG angiography in the setting of AVM surgery.

Participants/Methods: 10 patients were included in this prospective study. The authors assessed the utility of ICG angiography to visualize AVM vessels and to assess for residual AVM.

Results: ICG angiography was found to be useful by the surgeon in 9 of 10 patients. In 8 patients, it helped to distinguish AVM vessels. In 3 of 4 patients undergoing a post-resection injection, it demonstrated that there was no residual arteriovenous shunting. In 1 patient, it helped to identify a small AVM nidus that was otherwise inapparent within a hematoma. Intraoperative digital subtraction angiography (DSA) showed residual AVM in 2 of 10 patients requiring further resection of AVM not visualized during surgery.

Conclusions: ICG angiography makes up for many of the limitations of DSA. It has its own limitations in identifying persistent early venous drainage and residual AVM. The authors conclude that DSA remains the "gold standard" but that ICG should be used as a complementary tool to DSA.

Reviewer’s Comments: I agree with the authors that ICG angiography does not replace invasive angiography as a tool to assess AVM resection. ICG, however, can be very helpful in assessing the extent of the lesion and vessels en passage. A major limitation of the technique is that, unlike digital subtraction invasive angiography, one can see only what is visible under the microscope. We have found ICG angiography most useful during aneurysm surgery, as well as dural arteriovenous fistula surgery. (Reviewer-Bernard R. Bendok, MD).

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Keywords: Arteriovenous Malformation, Indocyanine Green, Intraoperative Angiography, Surgical Microscope

Print Tag: Refer to original journal article
Awake Craniotomy Is Safe, Effective

Outcome of Fully Awake Craniotomy for Lesions Near the Eloquent Cortex: Analysis of a Prospective Surgical Series of 79 Supratentorial Primary Brain Tumors With Long Follow-Up.

Pereira LCM, Oliveira KM, et al:

Acta Neurochir (Wien) 2009; 151 (October): 1215-1230

Awake craniotomy is a useful adjunct to surgical resection of primary brain tumors near eloquent brain areas.

Background: Awake craniotomy (AC) is used to increase safety of removing lesions from eloquent brain areas (EBAs). Outcomes of AC have not been well characterized.

Objective: To determine short- and long-term outcomes in patients treated with AC for primary supratentorial brain tumors (PSBT) near EBAs.

Design: Single-institution prospective case series.

Participants/Methods: All patients with radiological lesions typical for PSBT near eloquent cortex or fiber bundle between 1 and 10 cm diameter treated with AC were analyzed. Group A comprised 33 patients from 1998 to 2004 treated without a multi-disciplinary team; these were compared with 46 patients treated from 2004 to 2007 with a multi-disciplinary team (group B; neurosurgeon, neurologist, neuro-physiologist, neuro-anesthesiologist, and neuro-psychologist). Patients who had not undergone previous craniotomy (group 1) were compared to those with previous craniotomy (group 2). Anesthesia was multi-drug until 2002, and fentanyl only after 2002. Bipolar cortical stimulation with 8- and 16-subdural electrode grids and disposable bipolar electrodes were used. Regular clinical intraoperative exams included motor, sensory, speech, memory, attention, and cognitive testing. Surgical intent was maximal tumor removal. Tumor was removed until 20% functional loss persisting at least 30 minutes was determined. Patients had clinical follow-up every 120 days and MRI 1 to 6 times per year until February 2008.

Results: 79 patients aged 19 to 73 years (mean, 39.3 years) had AC. Presenting symptoms included seizure (93.6%) and headache or neurological deficit (50.6%). Tumor volume was similar in all groups (mean, 51.1 cm3). Group 1 had more left parietal tumors, and group B more left insular tumors. Mean tumor reduction (90.8%) and residual tumor volume (mean, 7.7 cm3) were similar. Gross total resection was similar (31.6%). Improvement in preoperative deficits was similar between groups (motor 75.0%, articulatory speech 61.3%, memory 17.4%). Group B patients had better semantic speech recovery but increased motor worsening (8.9%). At study conclusion, 50% (all groups similar) remained tumor-free. Death from tumor recurrence or malignant transformation was similar between groups.

Conclusions: AC for PSBT near EBAs can be associated with 90% tumor volume reduction, 40% patient clinical improvement, and 10% risk of neurological worsening.

Reviewer’s Comments: This study shows that AC can be safe and effective in treatment of PSBT near EBAs. Even though use of a multi-disciplinary team did not impact the outcomes assessed, it may have made the procedure more fluid and easier on the patient and surgeon; such data were not reported. Analysis of data on the basis of anesthetic technique would have been helpful, as this portion of the procedure can be the most problematic. The risk of neurological deficit is likely related to degree of functional loss permitted during the surgical procedure. The ability to perform AC is an essential component for neuro-oncological centers. (Reviewer-N. Scott Litofsky, MD).

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Keywords: Supratentorial Primary Brain Tumors, Awake Craniotomy, Eloquent Cortex

Print Tag: Refer to original journal article
Newer techniques of radiosurgery delivery demonstrate a lower vestibular schwannoma tumor control rate than previously reported.

**Background/Objective:** Gamma knife radiosurgery is considered a low-risk alternative to microsurgical treatment of vestibular schwannoma (VS). In recent years, the procedure has undergone technical changes to keep morbidity low, but long-term rates of tumor control have not been adequately evaluated.

**Design/Participants:** Retrospective review of 293 patients with VSs treated with radiosurgery between 1990 and 2004.

**Methods:** Each patient was followed up with imaging for a minimum of 24 months. Overall median radiation dose was 13 Gy. Mean follow-up was 60.9 months.

**Results:** Tumor growth, defined as tumor enlargement over ≥2 imaging studies, was noted in 5% of patients at 32 months of median follow-up. Statistical analysis demonstrated 2 associated factors correlating with treatment failure: increasing numbers of isocenters and radiation dosage at the tumor margin ≤13 Gy, although in a multivariate analysis, only increased isocenter number was found to be significant.

**Conclusions:** Newer techniques of radiosurgery delivery demonstrate a lower VS tumor control rate than previously reported. This may be due to distortion of stereotactic MRI coupled with increased radiosurgical conformity and progressive dose reduction.

**Reviewer's Comments:** This study is important because recent management trends have shifted toward promoting gamma knife radiosurgery as a first-line management option for VSs in many neurosurgical practices. Long-term control rates of newer methods of radiosurgery delivery have not been adequately reported, and this study would indicate that the failure rate is as high as 5% at 32 months of follow-up. At longer time intervals, this failure rate may be expected to rise even higher. The authors provide possible explanations for these somewhat surprising findings, including MRI distortion, use of a large number of small isocenters, and automated patient positioning. Most likely is the possibility that, in an effort to reduce morbidity and damage to cranial nerve structures, lower radiation delivery has resulted in a correspondingly larger incidence of treatment failure and tumor growth. This information is of critical importance in counseling patients, particularly younger patients with smaller tumors in whom long-term control rates of tumor treatment with radiosurgery are not completely known. In these patients, microsurgical management should still be the treatment of choice. (Reviewer-Nicholas C. Bambakidis, MD).

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Keywords: Acoustic Neuroma, Radiosurgery, Vestibular Schwannoma

Print Tag: Refer to original journal article
Twice-Daily Tramadol Reduces Need for Opiates, Shortens LOS After Craniotomy

Rahimi SY, Alleyne CH Jr, et al:

J Neurosurg 2009; July 24 (): epub ahead of print

Opioid-sparing drugs after craniotomy include cyclooxygenase-2, gabapentin, acetaminophen, and tramadol. By themselves, none of these drugs are sufficient to achieve pain control.

Background: In post-craniootomy patients, opiates can induce somnolence, respiratory depression, brain swelling secondary to hypercarbia, miosis, nausea, and vomiting, all of which complicate management. One way to decrease the amount of opiates and their side effects is to give an adjuvant medication such as tramadol.

Objective: To determine if scheduled administration of tramadol decreases the need for opiates in postoperative craniotomy patients.

Design: Prospective, randomized double-blind study.

Participants/Methods: 25 patients received tramadol 100 mg twice daily, and 25 received a placebo. All patients underwent elective craniotomy for tumors, vascular lesions, or epilepsy. Postoperatively, pain levels were measured using a visual analog scale (VAS). In both groups, pain was treated with as-needed oxycodone/acetaminophen 5/325 mg, given as 1 to 2 tablets every 4 hours, and IV morphine, 1 to 2 mg given every 2 hours. Outcome measures were VAS score, length of stay (LOS), use of opiates, and use of antiemetics.

Results: Both the LOS and the VAS were shorter in the tramadol group. Also, patients receiving tramadol requested less morphine. Requirements for oxycodone/acetaminophen as well as anti-nausea medicine were the same in both groups.

Conclusions: Tramadol is an effective adjuvant medication to control postoperative craniotomy pain. Adding tramadol to the standard regimen of opiates will benefit patients and reduce the cost of care.

Reviewer's Comments: This manuscript provides new data to support use of adjuvant medications with opiates to provide safer analgesia after craniotomy. While tramadol has advantages over NSAIDs, it has problems of its own, including lowering seizure threshold, inducing nausea, and increasing the risk of a serotonin syndrome, especially when combined with other medications such as antidepressants and opiates. In their discussion, the authors indicate that when NSAIDs are given after surgery, they are a major cause of perioperative bleeding, based on a 1994 reference in which patients had taken NSAIDs prior to surgery. There is, however, evidence that NSAIDs have a role in the treatment of postoperative pain in patients with low risk for cardiovascular events as reviewed in 2007 by Nemergut and colleagues (Best Practice & Research Clinical Anesthesiology). Scalp infiltration with local anesthetic as a means of reducing postoperative pain could be improved by injecting local anesthetic in the neurovascular fascia of the scalp nerves. The American Society of Regional Anesthesia has recently developed new methods for producing more efficient nerve blocks using ultrasound. However, this remains to be applied to scalp nerves. Finally, neurosurgeons should be aware that multiple studies have shown that moderate doses of gabapentin also decrease the amount of opiates needed to treat postoperative pain (Türe et al, 2009, Anesth Analg, in press). (Reviewer-Luc Jasmin, MD).

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Keywords: Postoperative Pain, Management, Opiates, Adjuvant Medication, Cost Analysis

Print Tag: Refer to original journal article
Decreased Platelet Activity Associated With Greater IVH Post-ICH

Reduced Platelet Activity Is Associated With More Intraventricular Hemorrhage.
Naidech AM, Bendok BR, et al:


Intraventricular hemorrhage is a serious complication of intracerebral hemorrhage.

**Background:** >50% of patients with intracerebral hemorrhage (ICH) die. ICH can be associated with intraventricular hemorrhage (IVH), which carries worse outcomes due to obstructive hydrocephalus. IVH can also occur alone. The pathophysiology behind IVH remains elusive. The authors had published in an earlier report that decreased platelet activity correlated with more IVH.

**Objective:** To demonstrate whether decreased platelet activity would be correlated with greater IVH and poorer outcomes following ICH.

**Participants/Methods:** Consecutive patients presenting with ICH were prospectively included. Excluded were patients with ICHs due to trauma, aneurysm rupture, arteriovenous malformation rupture, vasculitis, or other intracerebral lesions. Clinical and laboratory data were prospectively gathered; ICH volume at presentation was calculated using the ABC/2 formula. IVH was measured according to the scale developed by Graeb et al and classified into: 0 (no IVH); 1 or 2 (small IVH); 3 to 5 (moderate IVH); ≥6 (severe IVH). Medication history was reviewed by the ICU pharmacist, and aspirin dose was prospectively recorded. Outcomes at 14 days or discharge, whichever came first, were determined using the National Institutes of Health Stroke Scale (NIHSS) and the modified Rankin Scale (mRS). Follow-up mRS scores were recorded at 28 days and 3 months. Platelet activity was measured at presentation using the VerifyNow-Aspirin assay, and clopidogrel activity was assessed using the VerifyNow-P2Y12 assay.

**Results:** Most patients were African American and had hypertension. On admission, median Glasgow Coma Scale (GCS) score was 13, median NIHSS was 12, and mean ICH volume was 16 mL. Of patients, 14% used 81 mg of aspirin daily, 12% used 325 mg of aspirin daily, 7% used clopidogrel, and 10% used warfarin. Aspirin dose was significantly correlated with platelet activity as determined by the assay, but not with IVH. When comparing aspirin 81 mg versus 325 mg, no difference in platelet activity was noted. Clopidogrel demonstrated less platelet activity when using the aspirin assay and more inhibition when using the P2Y12-assay. Univariate analysis showed that clopidogrel was significantly correlated with greater IVH, but multivariate analysis did not. Warfarin was not associated with platelet activity or IVH. Twenty-five percent of patients not taking aspirin or clopidogrel had decreased platelet activity. Larger IVH was significantly correlated with lower platelet activity in univariate analysis. Less platelet activity significantly correlated with larger IVH despite ICH location. Reduced platelet activity, larger ICH, and ICH location were significantly correlated with more severe IVH. Larger IVH significantly correlated with poorer NIHSS at 14 days as well as poorer mRS at 14 and 28 days and at 3 months.

**Conclusions:** Decreased platelet activity was significantly associated with larger IVH following ICH, and this correlation warrants further investigation.

**Reviewer's Comments:** The results of this study suggest that reduced platelet activity is associated with more severe IVH, wherever the ICH is located. However, prior warfarin use was unrelated to IVH severity in this study, and this relationship should be further investigated. Moreover, further work should be aimed toward analyzing whether normalizing platelet activity at patient presentation would affect outcome. (Reviewer-Ziad A. Hage, MD).

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Keywords: Intracerebral Hemorrhage, Intraventricular Hemorrhage, Outcomes, Platelets

Print Tag: Refer to original journal article
Emergency extracranial-intracranial bypass for acute ischemic stroke is safe and effective, and it can stop and even reverse symptom progression.

**Background:** In patients with cerebrovascular insufficiency from atherosclerotic disease who have failed medical therapy, extracranial-intracranial (ECIC) bypass is mainly performed on a nonemergent basis. While its efficacy remains contentious, surgical revascularization has been shown to have excellent outcomes in several reports.

**Objective:** To present the authors’ experience with ECIC bypass on an urgent basis in patients with acute ischemic stroke (AIS) despite aggressive medical therapy.

**Methods:** The authors retrospectively reviewed all ECIC bypass procedures performed at their institution over a 10-year period. Thirteen patients (5 men, 8 women) who underwent emergency ECIC bypass for AIS were identified. All were deteriorating symptomatically and were noted to have progressive ischemia on diffusion-weighted imaging (DWI) despite maximal medical therapy. None were candidates for endovascular intervention. Follow-up ranged from 6 months to 9 years. All patients underwent superficial temporal artery-middle cerebral artery (MCA) bypass and received intra-arterial heparin infusion intraoperatively and aspirin 325 mg daily postoperatively. Intraoperative angiography confirmed graft patency.

**Results:** Participants were aged 21 to 65 years. Most were young and previously healthy. At presentation, all were diagnosed with AIS on DWI. Most had watershed MRI changes. In all patients, CT, MRA, and 4-vessel cerebral angiogram were performed. Angiography showed severe stenosis of the supraclinoid internal carotid artery (ICA) in 8, the M1 segment of the MCA in 3, and the cervical/petrous ICA in 2. In a minimum of 10 cases, acute arterial dissection was thought to be the causal pathological mechanism. In all cases, minimal collateral flow was demonstrated. Xenon CT was done in 3 cases and CT perfusion in 10 cases, showing severe hypoperfusion in the involved vascular territory, as well as significant mismatch when compared with DWI. All patients received triple-H therapy, anticoagulation, and antiplatelet therapy. Eleven cases had rapidly evolving deficits during the initial 2 to 12 hours, while 2 had slower progression over 48 hours. All patients were given the choice between continued aggressive medical therapy and emergency bypass. All underwent DWI MRI on their way to the operating room to rule out a large MCA stroke. Time between decision to operate and achievement of anastomosis varied between 3.5 and 6.0 hours. All patients had patent bypasses upon completion of surgery as evidenced by intraoperative angiogram. Perioperatively, 5 patients had initial worsening of symptoms that returned to baseline within 96 hours, 6 had no change, and 2 had resolution of symptoms. All patients underwent postoperative MRI, which showed no new stroke. All had improved at 6 months; 5 had a remaining minor fixed deficit and 8 had total recovery. In all, 1-year MRI showed stable chronic watershed strokes with no new changes.

**Conclusions:** Emergency ECIC for AIS was safe and effective. It stopped symptom progression and even reversed them in most cases.

**Reviewer’s Comments:** As mentioned herein, emergent ECIC bypass for AIS is underreported. In this study, the authors reserved this procedure for patients who failed maximal medical therapy and were not candidates for endovascular treatment. These results are promising; however, they may vary widely depending on patient selection and neurosurgeon experience. (Reviewer-Ziad A. Hage, MD).

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Keywords: Brain, Bypass Procedure, Arterial Dissection, Revascularization, Stroke

Print Tag: Refer to original journal article
The recurrent lumbar disk herniation rate after primary surgery may be >10%.

Objective: To determine the health care cost of recurrent disk herniation.

Design: Retrospective review of institutional billing and accounting records.

Participants/Methods: Patients who underwent lumbar discectomy from 1997 to 2007 by 1 spinal surgeon were reviewed. A modified ProLo Functional Status score was assigned from a retrospective review of medical records. All recurrent lumbar disk episodes were identified and recorded after 1 year of follow-up. Health care costs were estimated by collecting hospital charge information for diagnostic imaging, hospital-based procedures, and inpatient or outpatient physical therapy.

Results: 156 consecutively treated patients were enrolled; 141 were available for follow-up at 1 year. Symptomatic recurrent disk herniation occurred in 17 patients (12%). Eleven of these patients (7%) underwent re-operation. Average cost of a recurrent disk herniation managed conservatively was $2315. The cost was much higher $39,836 ($P <0.001) if revision surgery was performed.

Conclusions: Recurrent disk herniation occurs in >10% of patients who undergo surgery. Costs associated with revision surgery are high. It is estimated that the cost of managing recurrent disk herniation is $289,797 per 100 primary discectomies.

Reviewer’s Comments: The authors have highlighted an important clinical problem and have focused on a timely topic: health care costs. Lumbar discectomy is the most common spinal procedure performed in the United States (approximately 300,000 procedures/year). The data presented here suggest that the rate of re-operation is >10% within 1 year of the index procedure. If we extrapolate from these data, then there are probably >21,000 lumbar disk re-operations performed in the U.S. per year. The authors do not make any suggestions for how this number could be reduced. Clearly, the importance of reducing the numbers of re-operations is important on purely clinical grounds, but as the authors point out, the importance is magnified when costs of re-operation are considered. Of note, the initial cost of the surgical episode was not presented in their manuscript. It is likely that the cost of re-operation is higher than that of the index procedure. (Reviewer-Zoher Ghogawala, MD).

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Keywords: Health Care Costs, Recurrent Disk Herniation

Print Tag: Refer to original journal article
The exophthalmos index is a useful, but as of yet, not validated measure of proptosis.

**Background:** Almost universally, patients with sphenoorbital meningiomas present with ocular symptoms, such as loss of visual acuity, pain, or exophthalmos. The exophthalmos is not always clinically appreciated or cosmetically significant, but present in the majority of patients at presentation.

**Objective:** To provide an objective measure of exophthalmos (the exophthalmos index) and track the result over a long-term follow-up period.

**Design/Participants:** Retrospective report of the results of 30 patients who underwent surgery for a sphenoorbital meningioma with a median follow-up of 61 months.

**Methods:** The medical and radiographic records of the study cohort were analyzed retrospectively. The exophthalmos index was calculated on radiographs.

**Interventions:** All patients underwent surgical intervention for the treatment of the sphenoorbital meningioma.

**Results:** All patients were women with a median age of 51 years. Median symptom duration before surgery was 10 months; 93% presented with exophthalmos; decreased visual acuity was seen in 23%; and 17% had pain associated with proptosis. Based on radiographic measurements, each patient's exophthalmos index was measured from the preoperative, early follow-up, and late follow-up scans. Although not the focus of the report, the surgical extent of resection was Simpson Grade II in 90% and Grade III in 10%. Recurrence was seen in 10% of patients, while the rest had stable radiographic images during the follow-up period. All patients had an exophthalmos index between 1.2 and 2.75 preoperatively. The severity of the exophthalmos index was not associated with preoperative symptom type or duration. At first postsurgical follow-up, clinical exophthalmos was improved in 86% of patients, while the exophthalmos index was improved in 90% of patients, and in 93% of patients at last follow-up. However, improvement was not sustained between the first and last follow-up scans, with only 20% of patients continuing to have improvement, 50% had worsening, and 30% had a stable index. Compared to the preoperative exophthalmos index, 87% had improved index at last follow-up, unchanged in 10%, and worse in 3%. Residual exophthalmos was related to residual or recurrent disease.

**Conclusions:** The authors’ exophthalmos index is a useful, but as of yet, not validated measure of proptosis. Worsening exophthalmos is often an indicator of residual or recurrent disease.

**Reviewer's Comments:** Sphenoorbital meningiomas are often slowly progressive and surgical intervention is technically difficult due to anatomic constraints. Most patients present with proptosis and this report proposes an objective measure for the determination of exophthalmos. The authors are to be commended for their proposal and this exophthalmos index needs validation in other series. The challenge remains whether this index is both radiographically and clinically relevant. (Reviewer-Kenji Muro, MD.)

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Keywords: Exophthalmos, Orbit, Proptosis, Sphenoorbital Meningioma

Print Tag: Refer to original journal article