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Subcortical damage is 'primary cause' of neurological deficits after 'awake craniotomy'

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Injury to the subcortical structures of the inner brain is a major contributor to worsening neurological abnormalities after "awake craniotomy" for brain tumors, reports a study in the February issue of *Neurosurgery*, official journal of the Congress of Neurological Surgeons.

During a procedure intended to protect critical functional areas in the outer brain (cortex), damage to subcortical areas—which may be detectable on MRI scans—is a major risk factor for persistent neurological deficits. "Our ability to identify and preserve cortical areas of function can still result in significant neurological decline postoperatively as a result of subcortical injury," write Dr. Victoria T. Trinh and colleagues of The University of Texas MD Anderson Cancer Center, Houston.

Risk Factors for Neurological Deficits after Awake Craniotomy

The researchers analyzed factors associated with worsening neurological function after awake craniotomy for brain tumor surgery. In awake craniotomy, the patient is sedated but conscious so as to be able to communicate with the surgeon during the operation.

The patient is asked to perform visual and verbal tasks while specific areas of the cortex are stimulated, generating a functional map of the

brain surface. This helps the surgeon navigate safely to the tumor without damaging the "eloquent cortex"—critical areas of the brain involved in language or movement.

The study included 241 patients who underwent awake craniotomy with functional brain mapping from 2005 through 2010. Of these, 40 patients developed new neurological abnormalities. Dr. Trinh and colleagues examined potential predictive factors—including changes on a type of MRI scan called diffusion-weighted imaging (DWI).

Of the 40 cases with new neurological deficits, 36 developed while the surgeon was operating in the subcortical areas of the brain. These are the inner structures of the brain, located beneath the outer, folded brain cortex. Just one abnormality developed while the surgeon was operating in the cortex only.

MRI Changes May Reflect Subcortical Damage

Neurological abnormalities developing while the surgeon was operating in the subcortex were likely to remain after surgery, and to persist at three months' follow-up evaluation. Dr. Trinh and coauthors write, "Patients with intraoperative deficits during subcortical dissection were over six times more likely to have persistently worsened neurological function at three-month follow-up."

In these patients, MRI scans showing more severe changes in the DWI pattern in the subcortex also predicted lasting neurological abnormalities. Of patients who had neurological deficits immediately after surgery and significant DWI changes, 69 percent had persistent deficits three months after surgery.

Patients who had "positive" cortical mapping—that is, in whom eloquent cortex was located during functional mapping—were somewhat more

likely to have neurological abnormalities immediately after surgery. However, the risk of lasting abnormalities was not significantly higher compared to patients with negative cortical mapping.

Awake craniotomy with brain stimulation produces a "real-time functional map" of the brain surface that is invaluable to the neurosurgeon in deciding how best to approach the tumor. The new results suggest that, even when the eloquent cortex is not located on cortical mapping, subcortical areas near the tumor can still be injured during surgery. "Subcortical injury is the primary cause of neurological deficits following awake craniotomy procedures," Dr. Trinh and colleagues write.

The researchers add, "Preserving subcortical areas during tumor resections may reduce the severity of both immediate and late neurological sequelae." Based on their findings, they believe subcortical mapping techniques may play an important role in avoiding complications after awake craniotomy.

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