



Surgical Adjuncts in Brain Tumor Surgery

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Honolulu, HI



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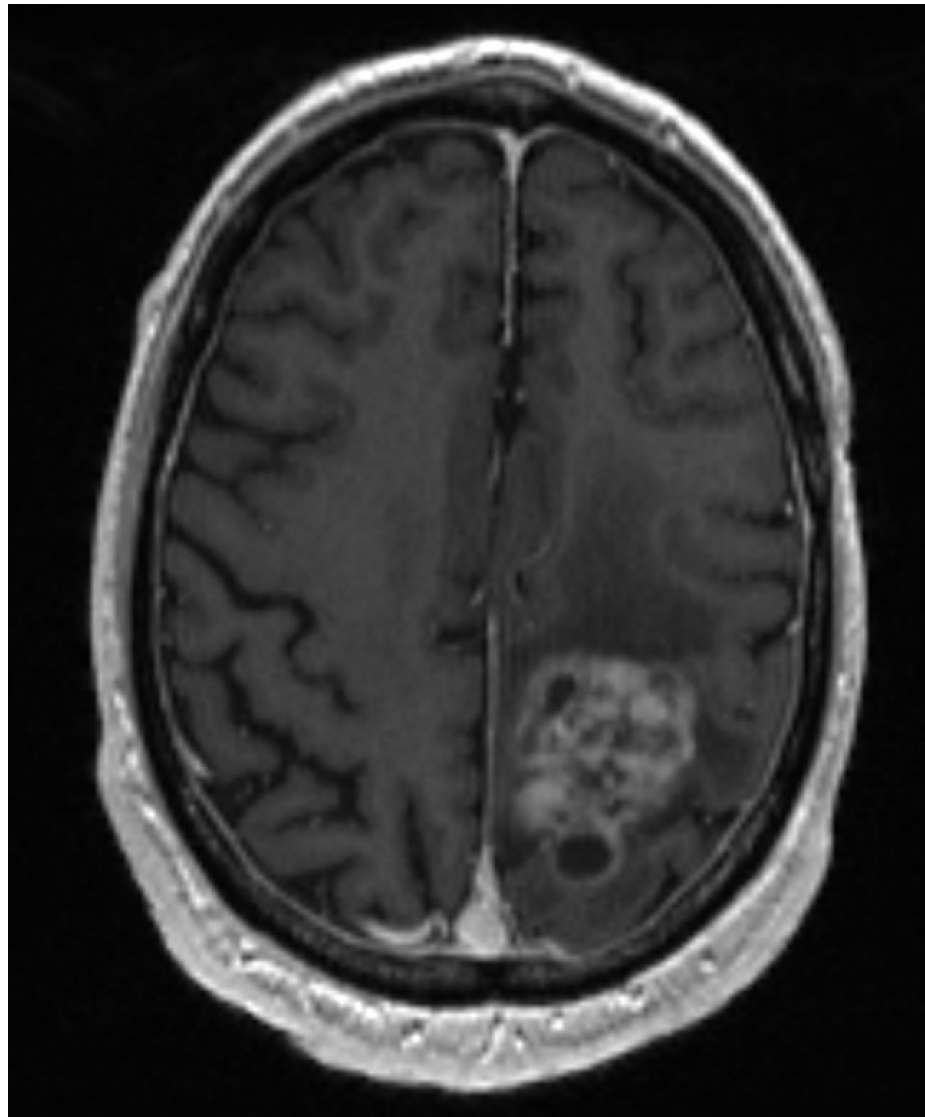
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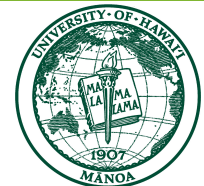
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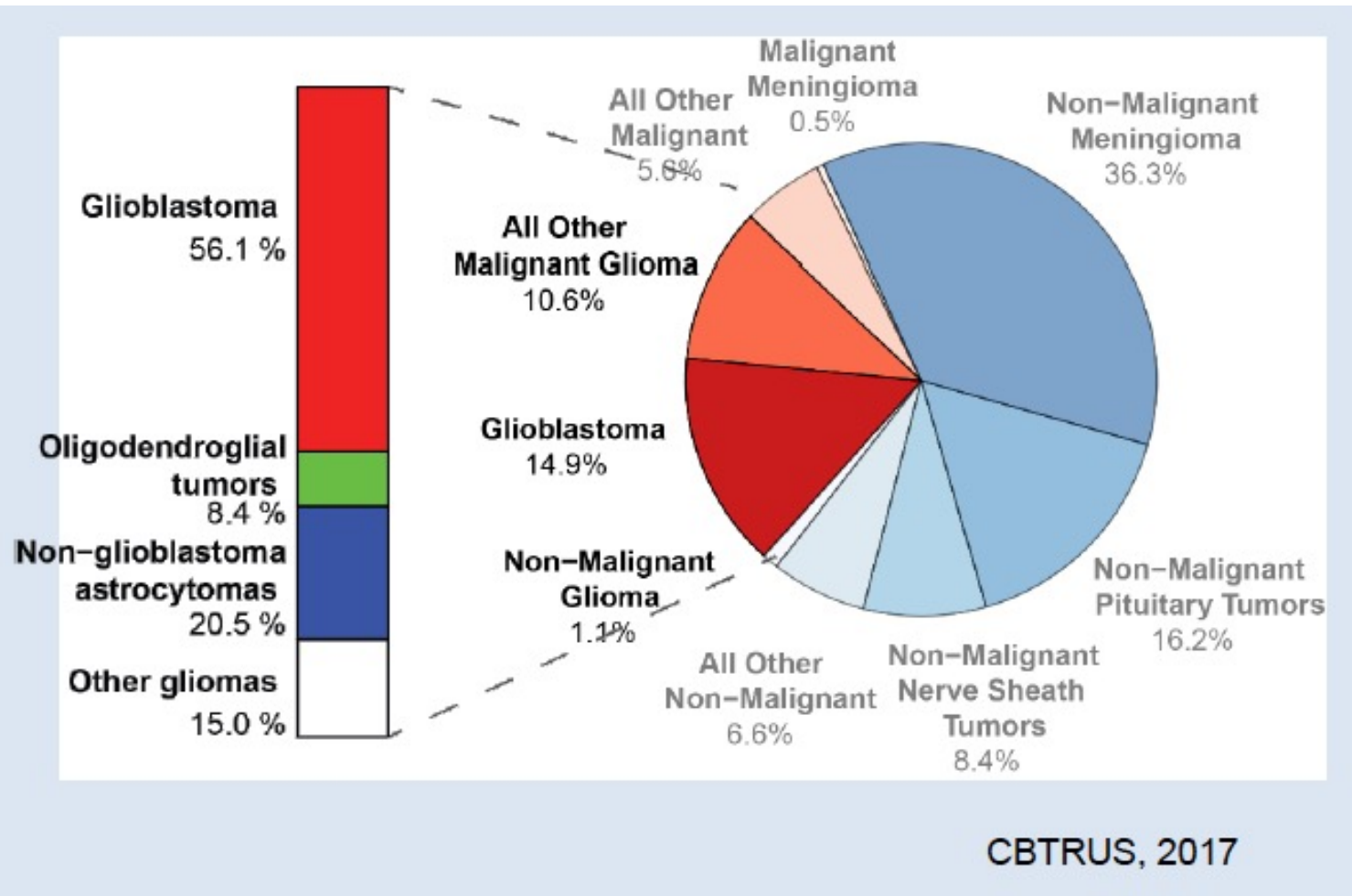
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Gliomas



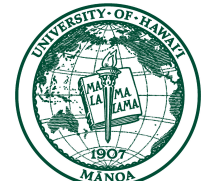
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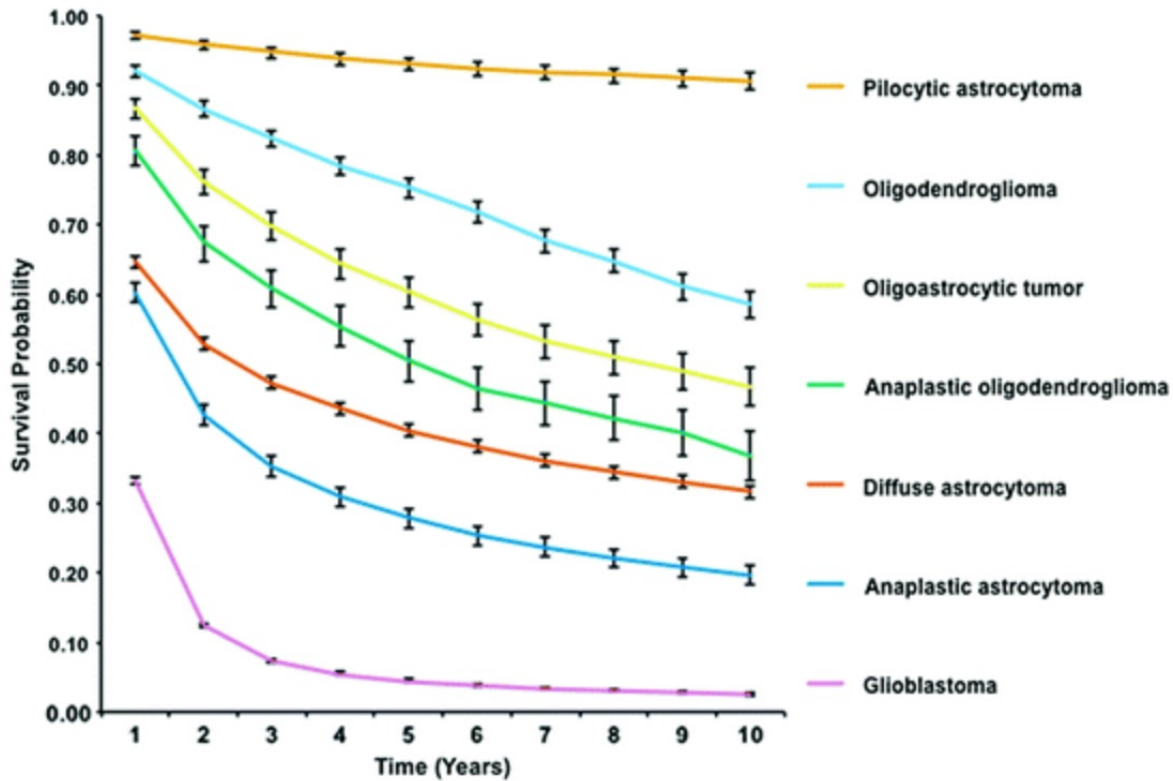
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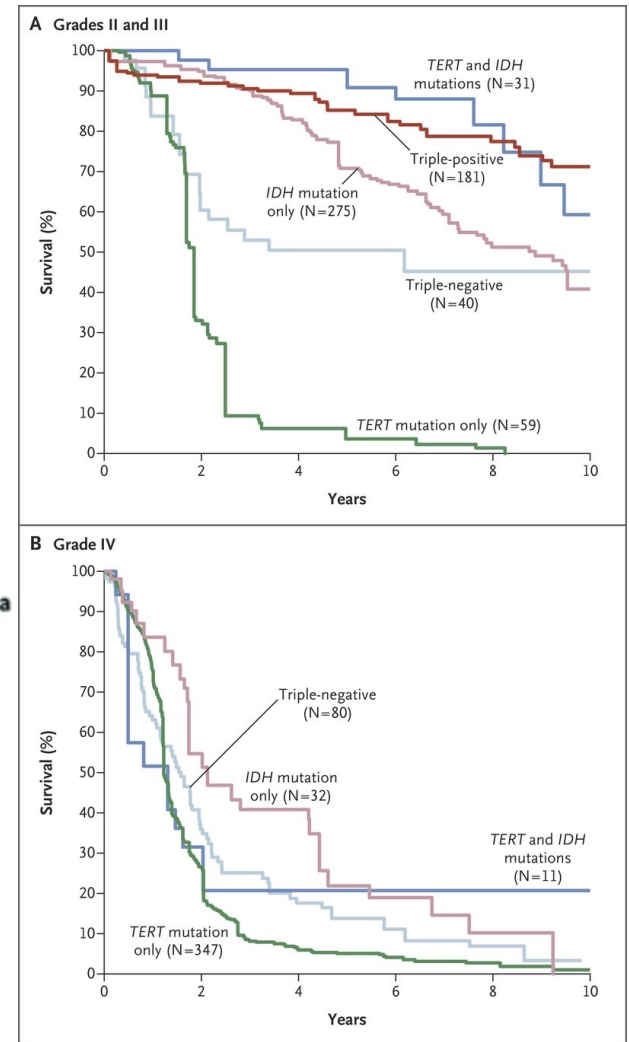
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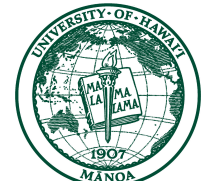
Prognosis



SEER, 1995-2010

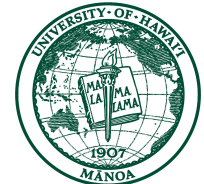
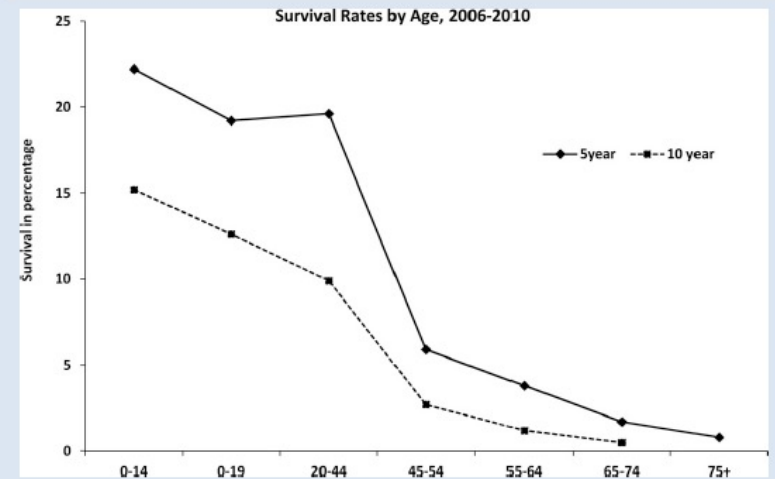
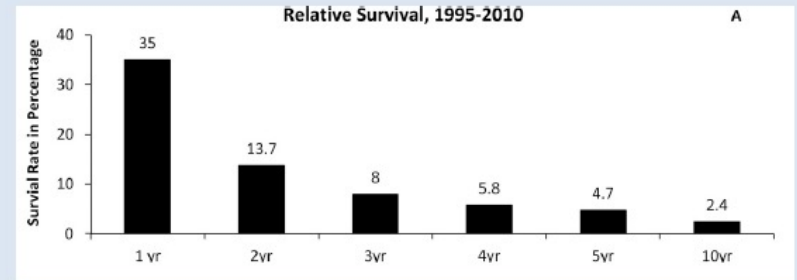


Eckel-Passow, NEJM, 2015



Prognosis

- Outcomes after diagnosis with glioblastoma are generally poor.
 - Median survival: 12 months (Stupp et al., 2005)
 - Five-year relative survival: ~5% (Thakkar et al., 2014; CBTRUS 2017)
- Several factors predict improved survival:
 - High Karnofsky Performance Score (KPS)
 - Younger age at diagnosis
 - Greater extent of surgical resection
 - Biomarkers (*MGMT* promoter methylation, mutation of *IDH1*)



Stupp Protocol

Surgery

- Pathological Diagnosis
- Alleviate mass effect
- Increase survival (dependent on EOR)
- Decrease need for corticosteroid

Radiotherapy

- Increase survival after surgery in newly diagnosed patients

Chemotherapy

- Extend survival
- Potentially increase therapeutic effect of RT



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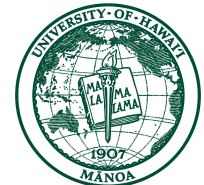
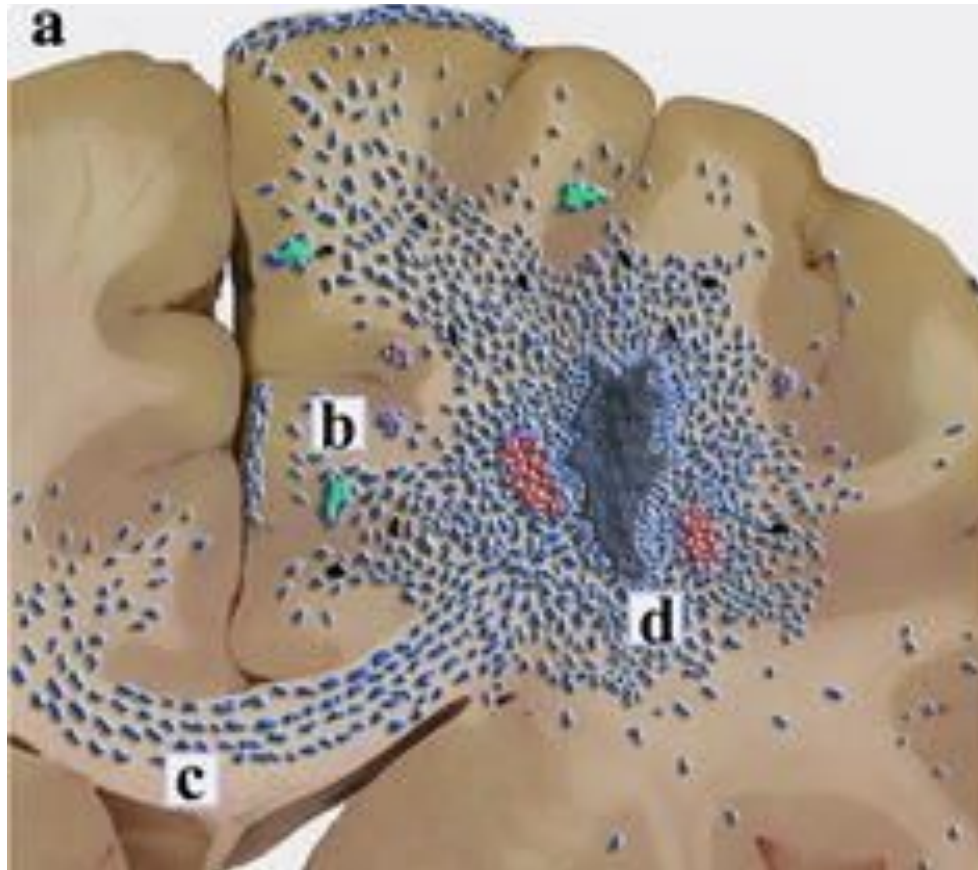
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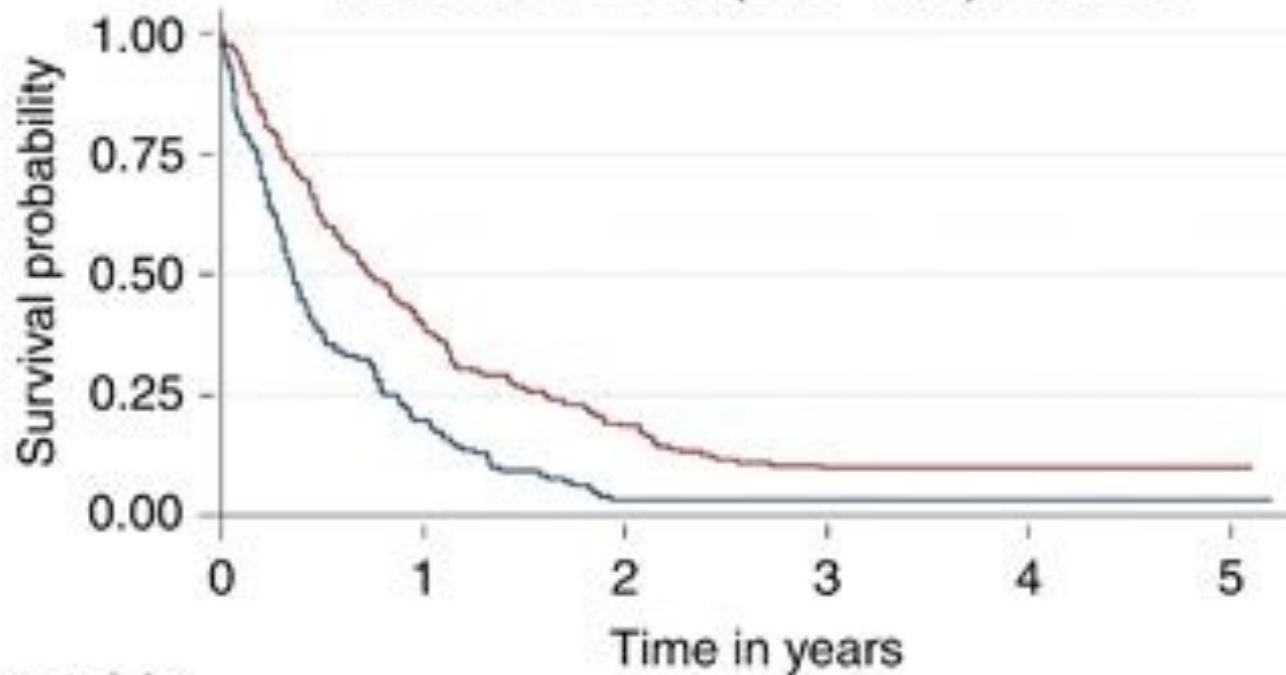
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Prognosis

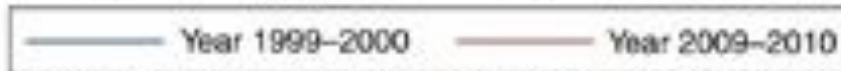


Kaplan–Meier survival estimates
 HR=0.56 95% CI: (0.45–0.71) $P<0.001$



Number at risk

	0	1	2	3	4	5
Year 1999–2000	133	26	4	3	2	2
Year 2009–2010	184	73	34	18	8	2



Median OS in 1999–2000 = 0.36, 1-year survival rate = 0.21 CI: (0.14 – 0.29)

Median OS in 2009–2010 = 0.74, 1-year survival rate = 0.40 CI: (0.33 – 0.47)

deSouza et al, 2016



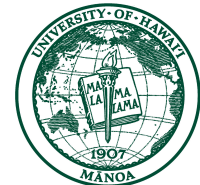
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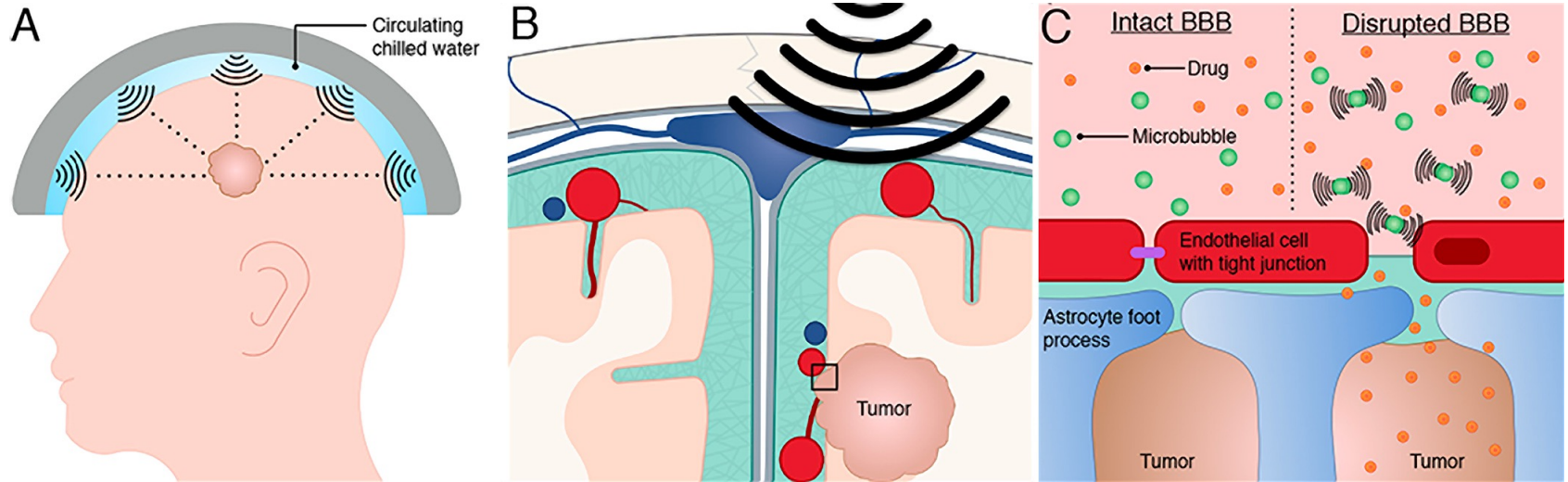
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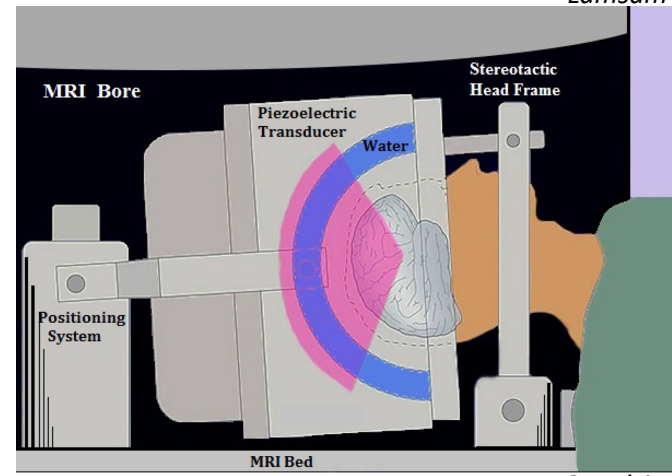
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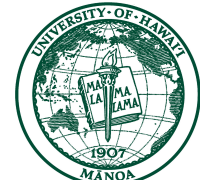
ExAblate: Focused Ultrasound to Increase BBB Opening



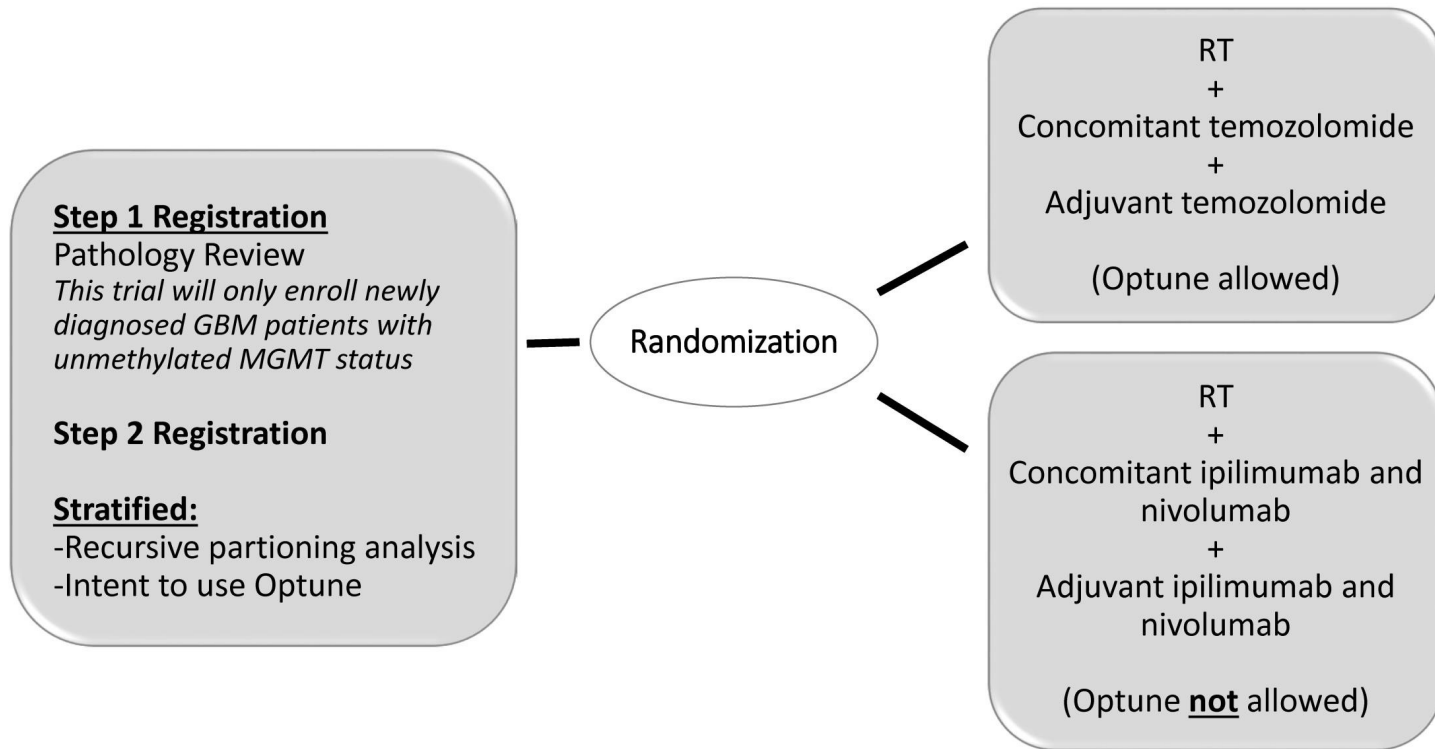
Lamsam et al., 2019

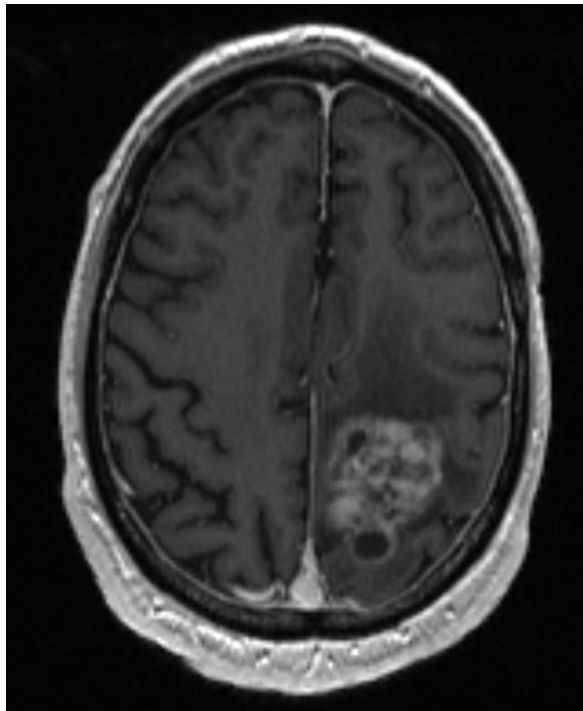


Quadri et al., 2017



NRG-BN007: A Randomized Phase II/III Open-Label Study of Ipilimumab and Nivolumab Versus Temozolomide in Patients with Newly Diagnosed MGMT Unmethylated Glioblastoma





Surgery

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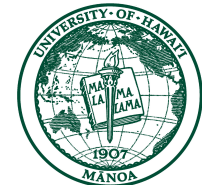
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Newly Acquired Deficits

- 360 patients s/p GBM resection
- Median survival (12.8mo) decreased in patients with **language deficits (9.6mo) and motor deficits (9.0mo)**
- **Two year-survival 8% (motor deficits) and 0% (language deficits) vs 23% without new deficits**

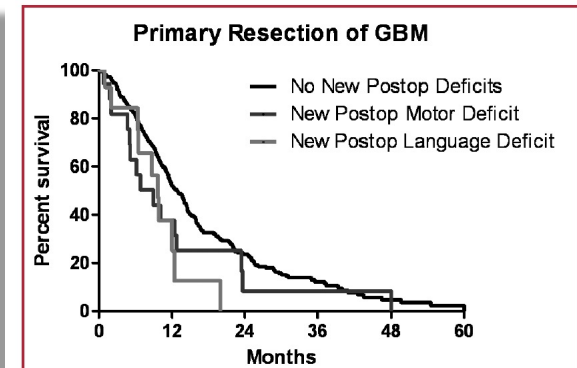


FIGURE 1. Kaplan-Meier plot demonstrating survival after resection of glioblastoma multiforme (GBM) in patients without a new postoperative (postop) neurological deficit, with a surgically acquired motor deficit, or with a surgically acquired language deficit. Patients with a new postoperative motor deficit ($P < 0.05$) or a new postoperative language deficit ($P < 0.05$) experienced decreased overall survival compared with patients without a new-onset perioperative neurological deficit.

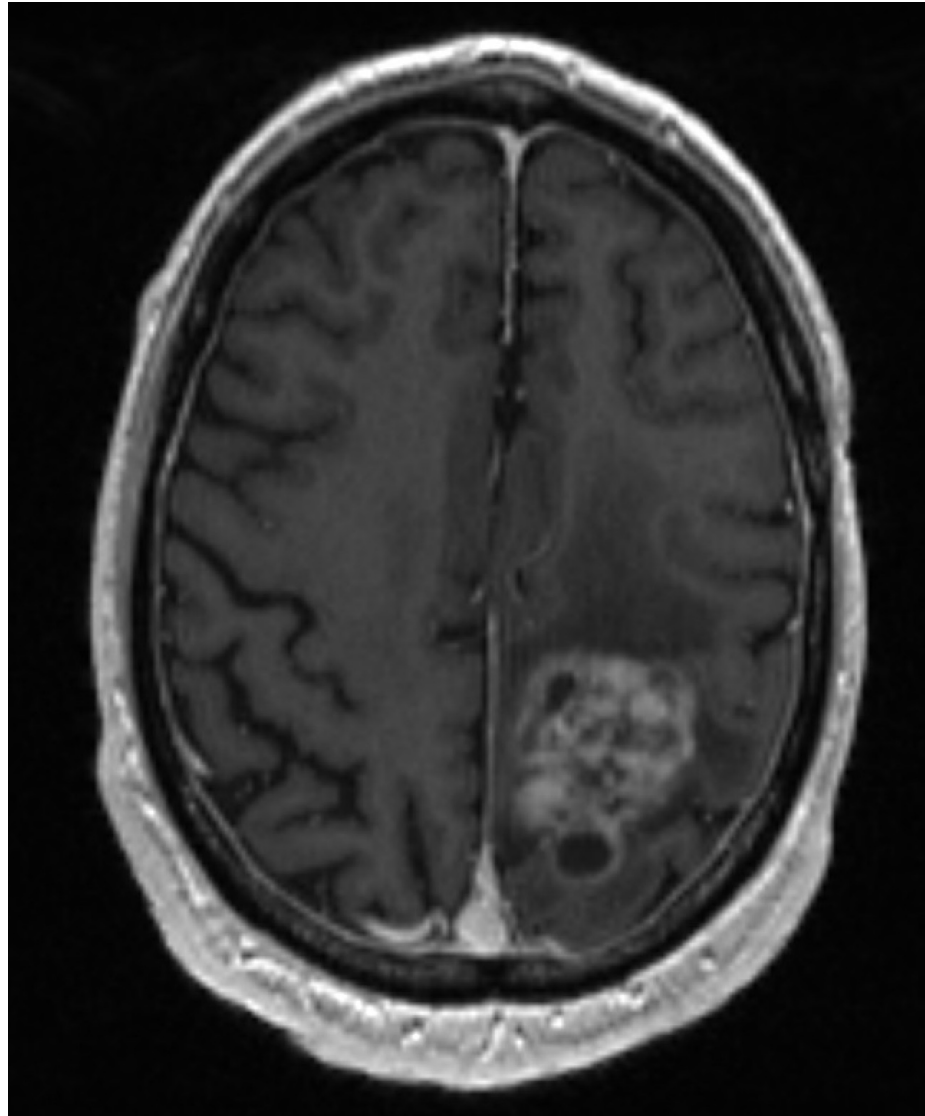
TABLE 1. Median and 2-year survival in patients who acquired a new perioperative motor deficit, a new perioperative language deficit, or did not acquire a new operative-induced neurological deficit^a

	Median survival (mo)	2-year survival (%)
New perioperative motor deficit	9.0	8
New perioperative language deficit	9.6	0
No new perioperative deficit	12.8	23

^a Patients with a new postoperative motor deficit ($P < 0.05$) or a new postoperative language deficit ($P < 0.05$) experienced decreased median overall survival compared with patients without surgically acquired deficits. Of the patients who had acquired an operative induced language deficit, none lived 2 years after primary resection of glioblastoma multiforme.

McGirt, Neurosurgery, 2009





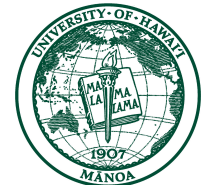
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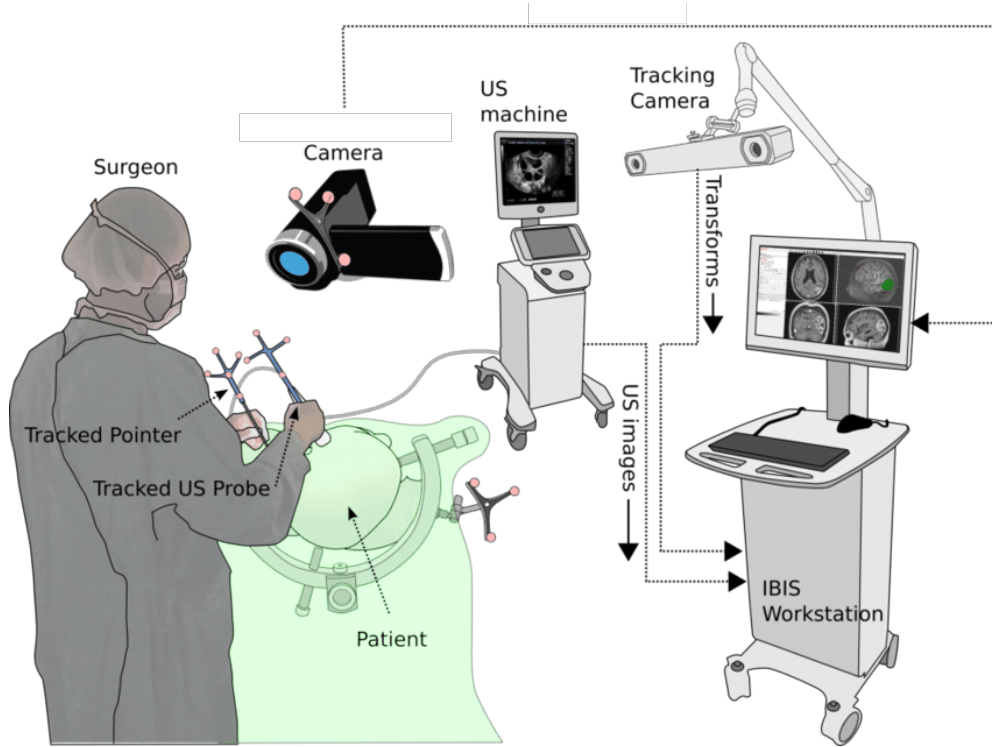
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Neuronavigation



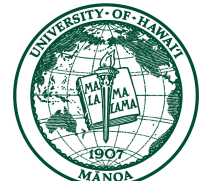
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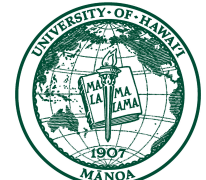
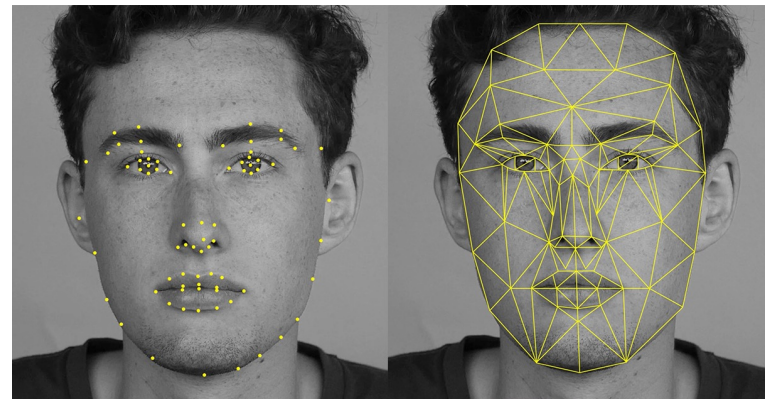
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NeuNav





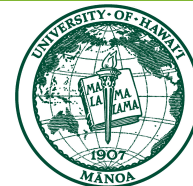
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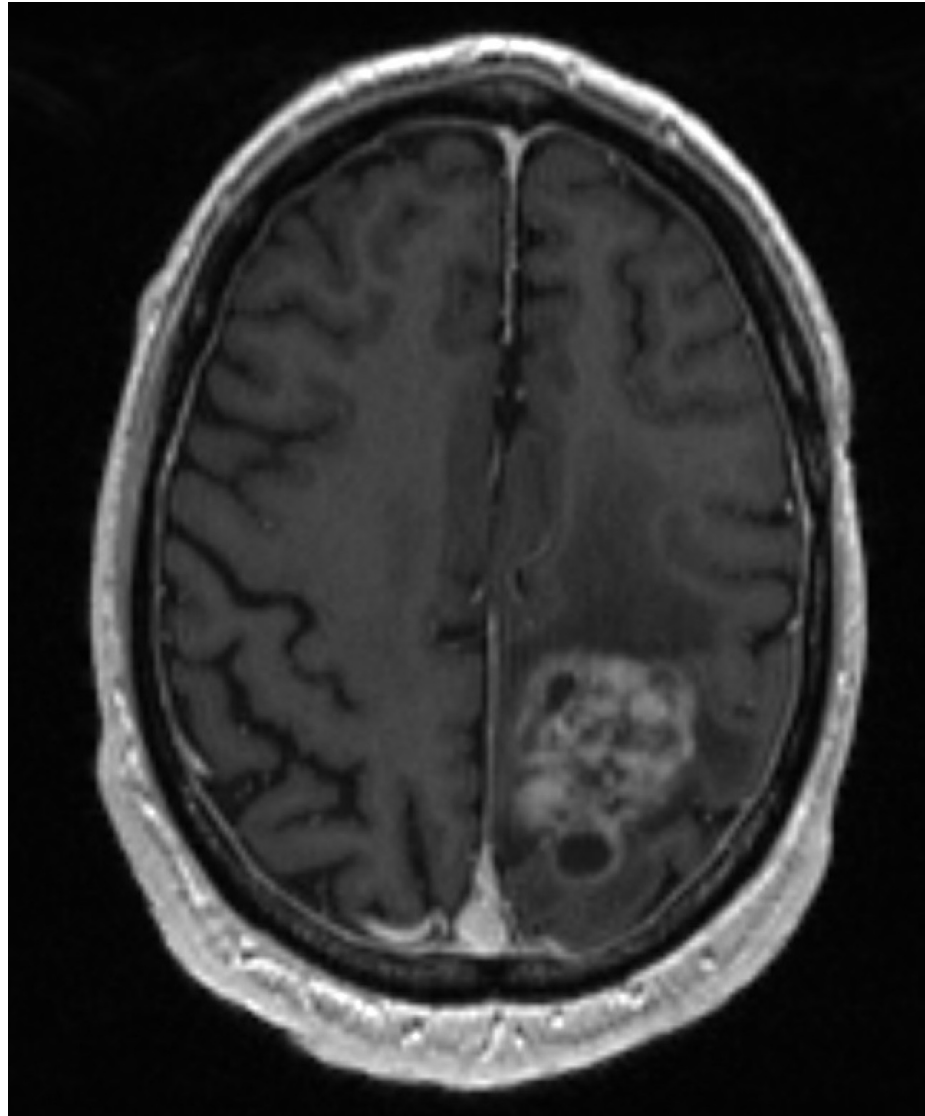
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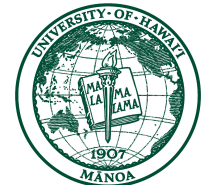
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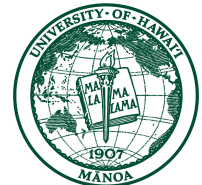
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Intraoperative MRI

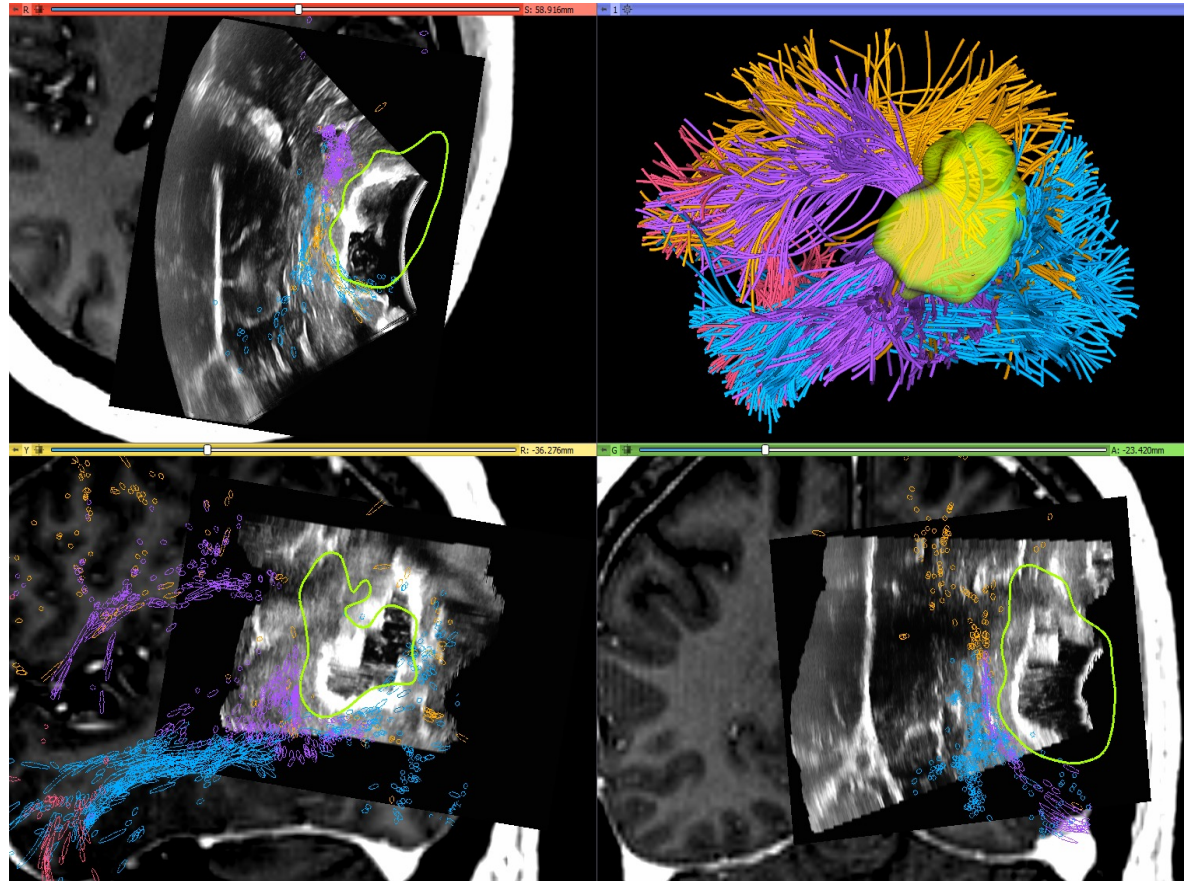


- Can identify an incomplete resection
- Updated navigation facilitates compensation for brain shift, edema, resection change, and CSF egress
- Particularly helpful in low grade gliomas
- Can also provide functional and metabolic submodalities in addition to newer developed therapies like laser interstitial thermal therapy
- Results in increased extent of resection and overall survival



Intraoperative 3D Ultrasound

- Ubiquitously available
- Real-time
- Can allow for re-registration after brain shift using feature-registration techniques



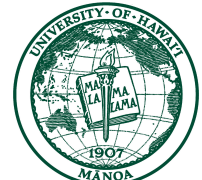
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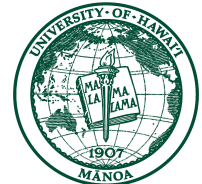
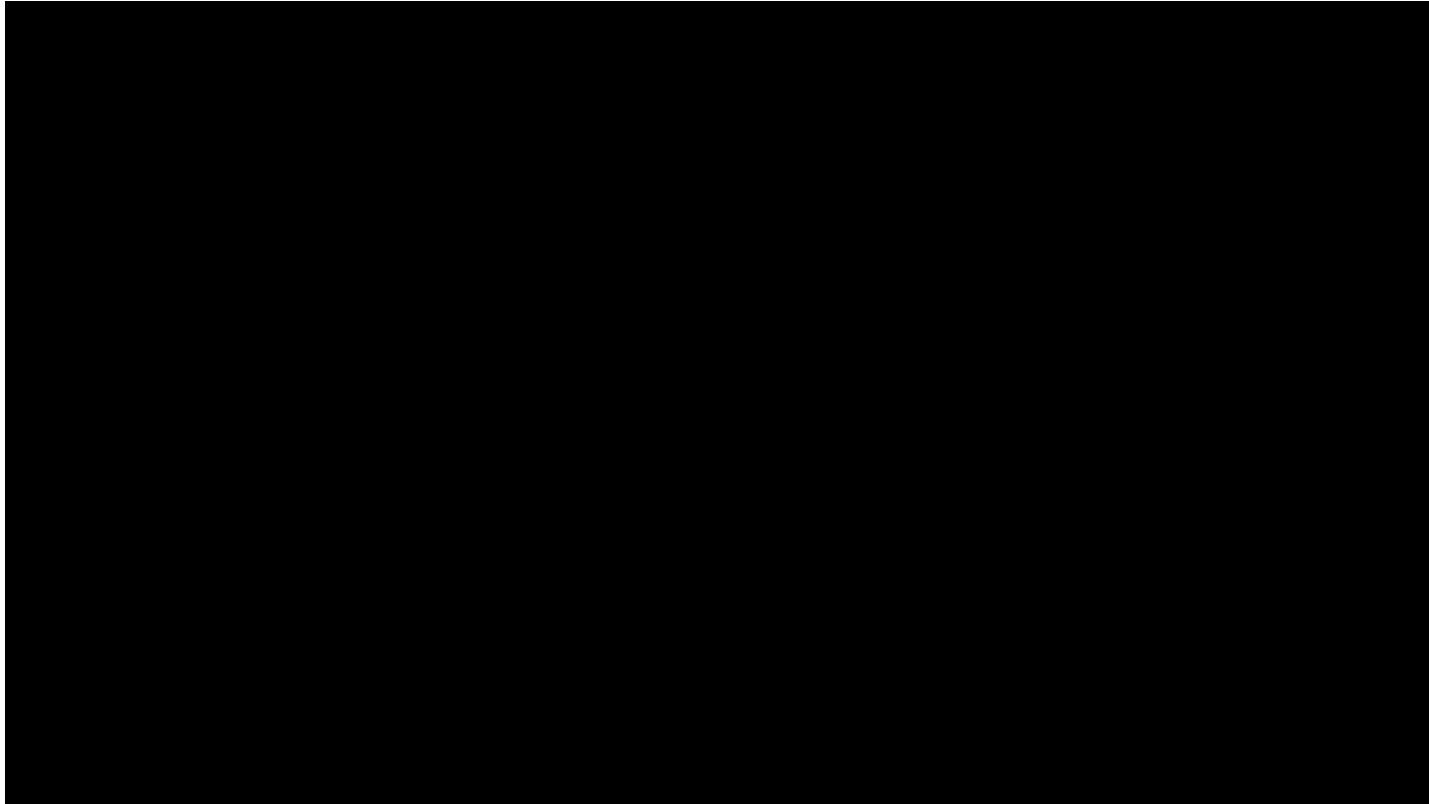
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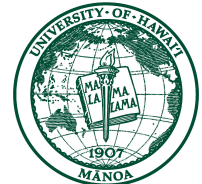
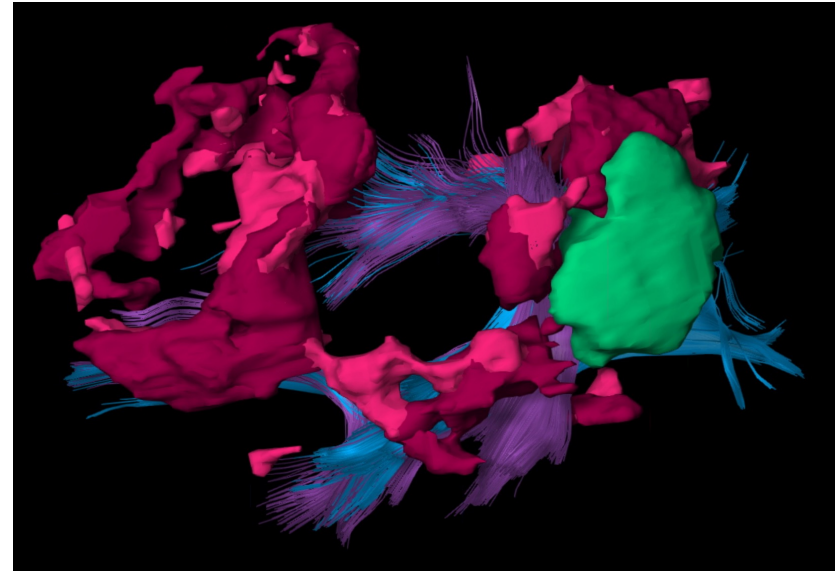


Awake Craniotomy



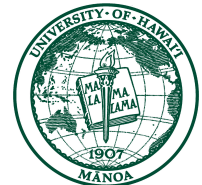
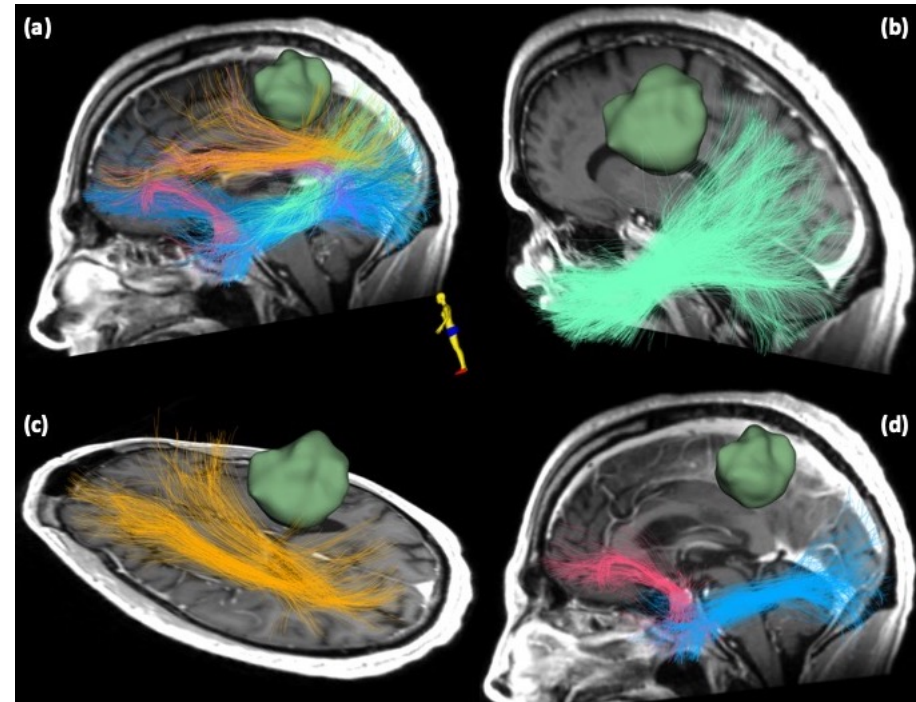
fMRI

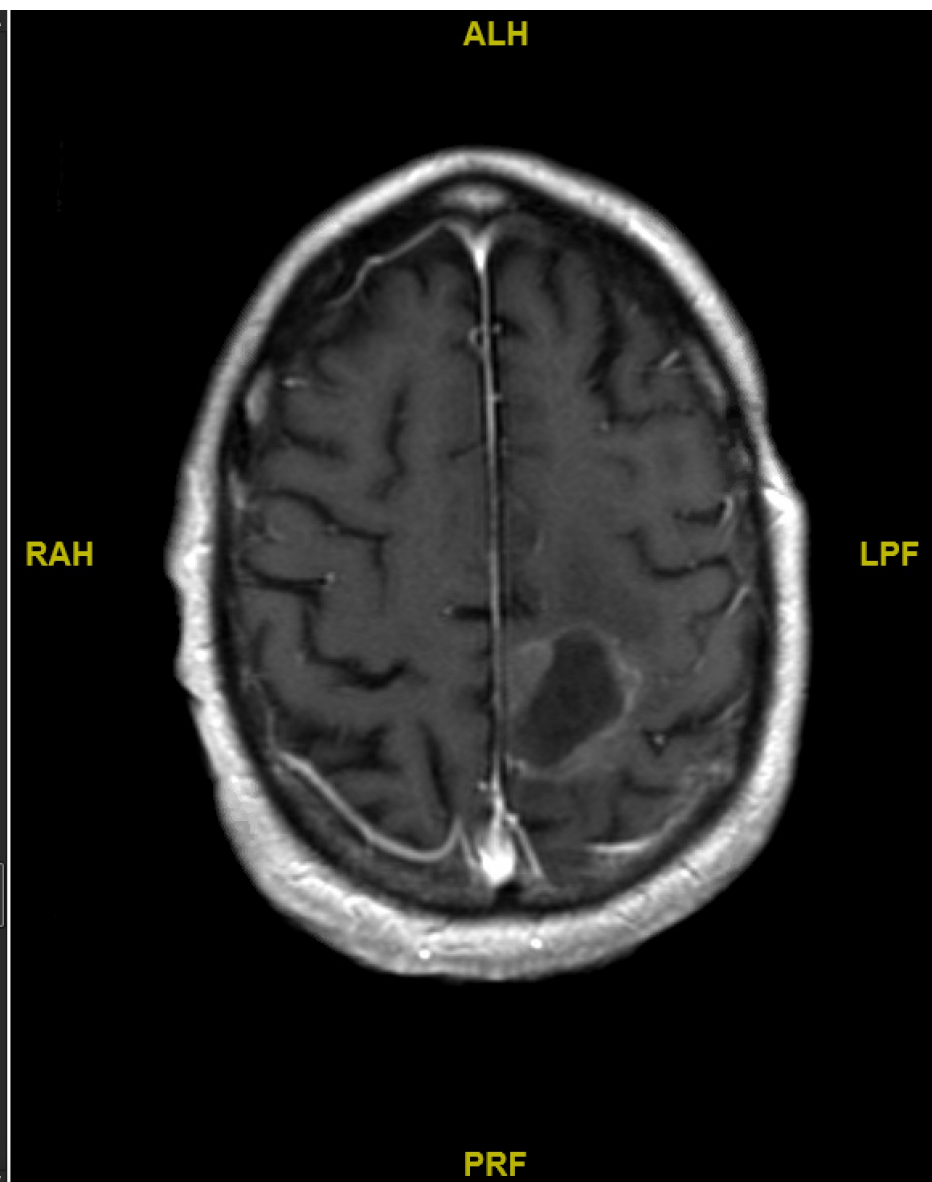
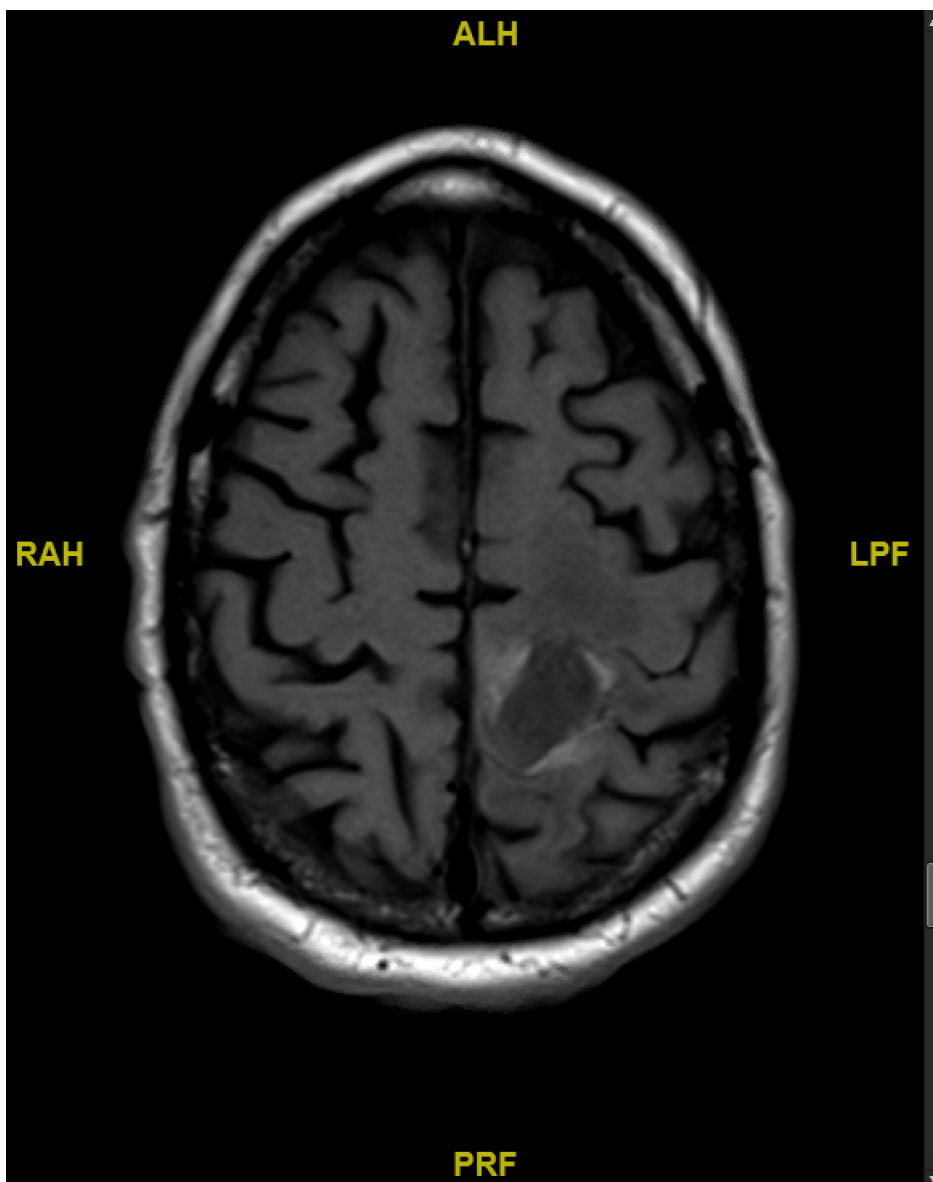
- One of the most commonly used imaging studies that allows localization of motor, sensory, visual, and language cortex
- Can help determine if the lesion is intimately involved with a key functional area, giving the surgeon more confidence during resection



Diffusion Tensor Imaging (DTI)

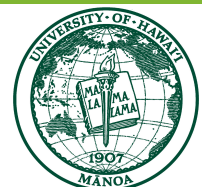
- DTI allows the surgeon to visualize the location of subcortical white matter tracts





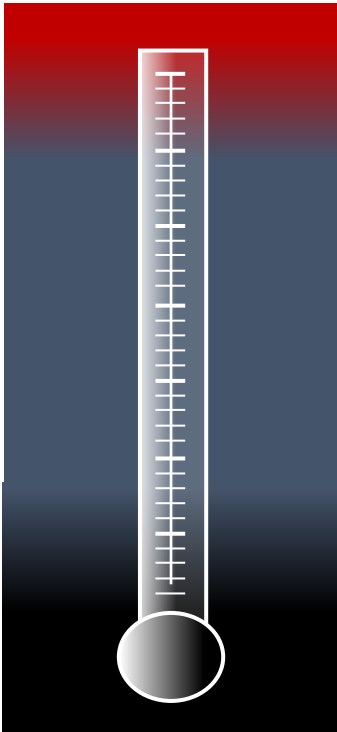
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What is Laser Thermal Ablation?

Thermal destruction of tissue by elevation to lethal temperatures



>100° C

Vaporization of intra- and extra-cellular water. Rupture of cell membranes.

60° - 100° C

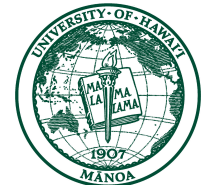
Instant denaturation of proteins and cellular components. Tissue coagulation.

44° - 59° C

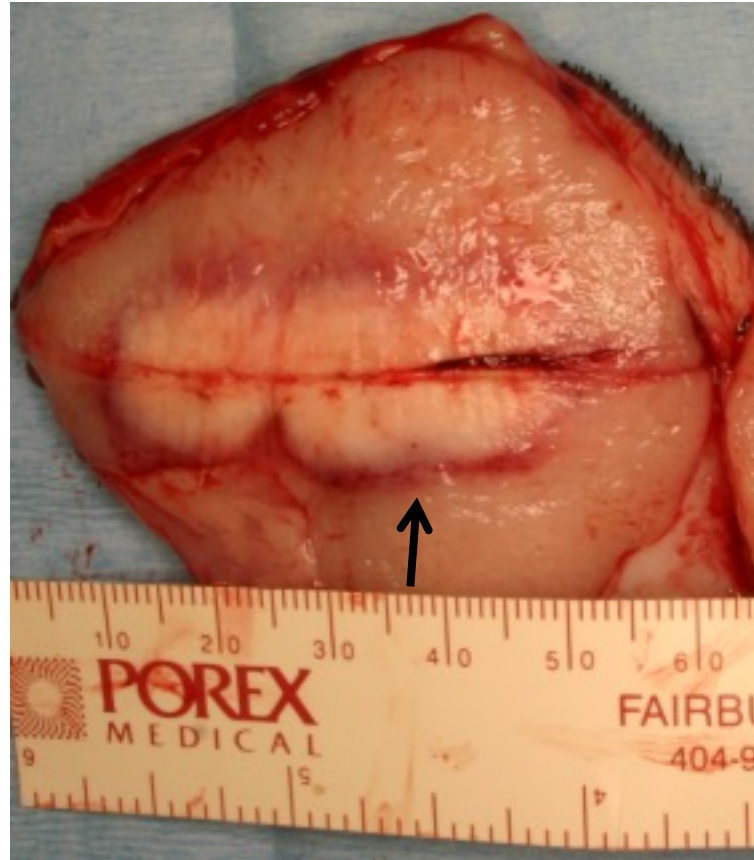
Time-dependent thermal damage. Thermal denaturation of critical enzymes; cell death.

~43° C

Critical temperature below which thermal damage does not occur regardless of exposure time



Sharp transition zone between dead and viable tissue



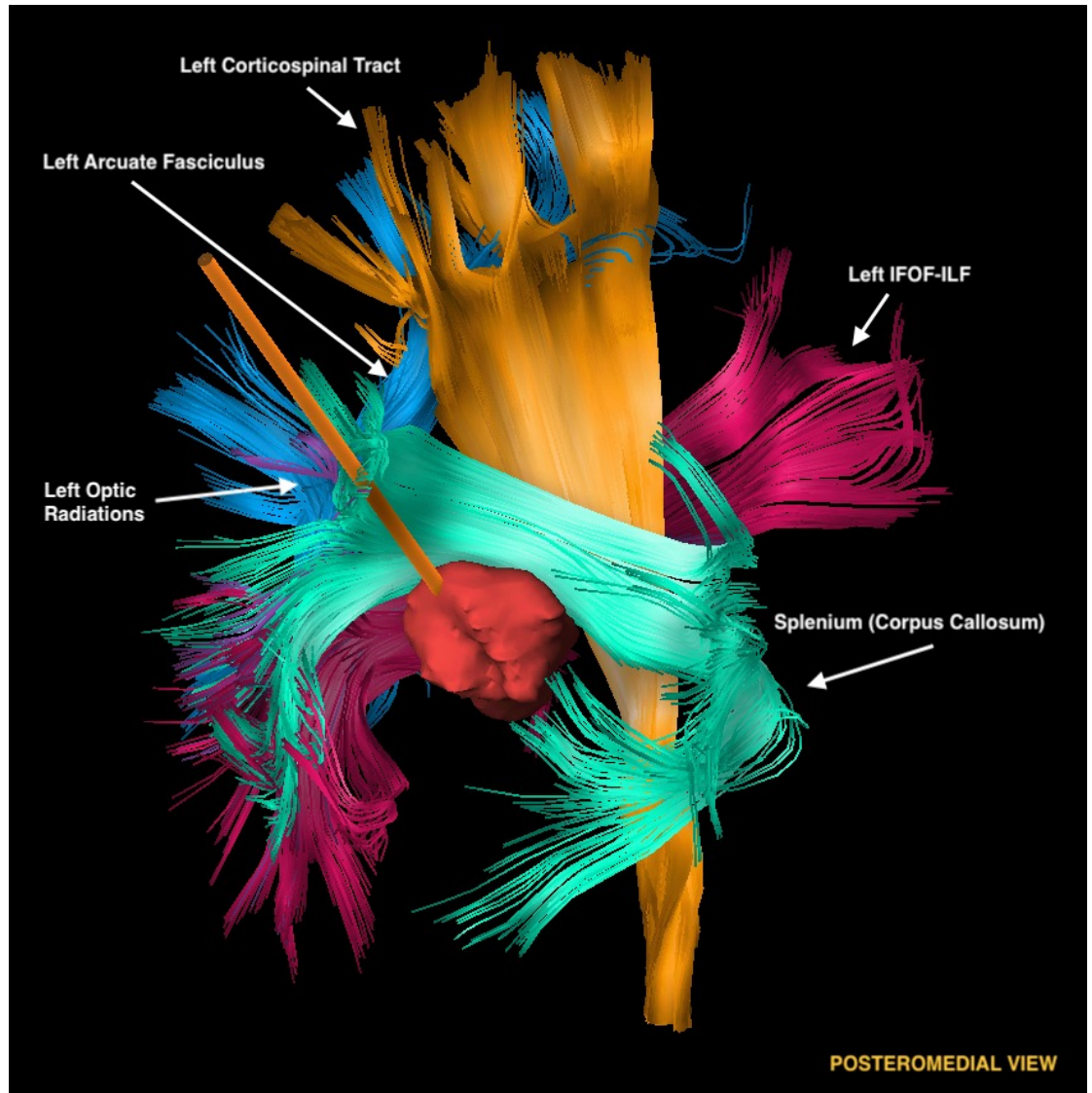
Transition can be approximately 1 mm¹³

Advantages

- Shorter hospital stays
- Reduced blood loss
- Less post-operative pain
- Ability to provide adjuvant chemotherapy or radiation sooner
- Radiation necrosis

Disadvantages

- Inability to treat large or irregular lesions
- Difficulty treating highly vascular lesions or lesions close to major blood vessels
- Transient edema leading to temporary deficits/intervention



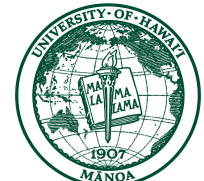
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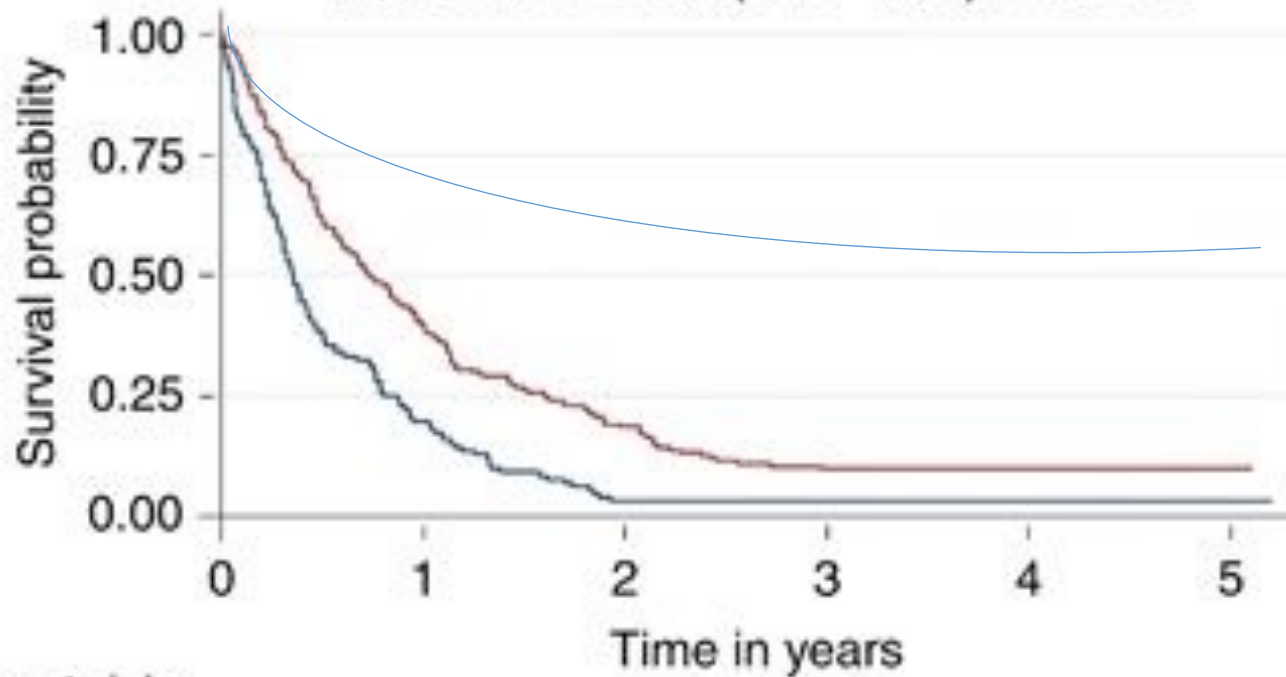
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— Year 1999–2000 — Year 2009–2010

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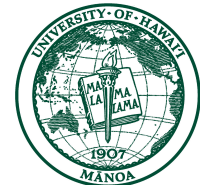
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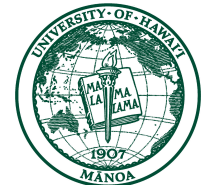
THANK YOU!



ThomasNohMD



Thomas.noh@hphmg.org





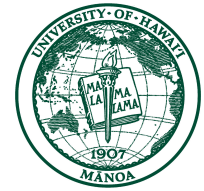
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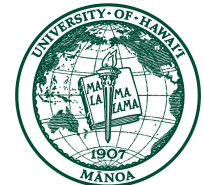
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