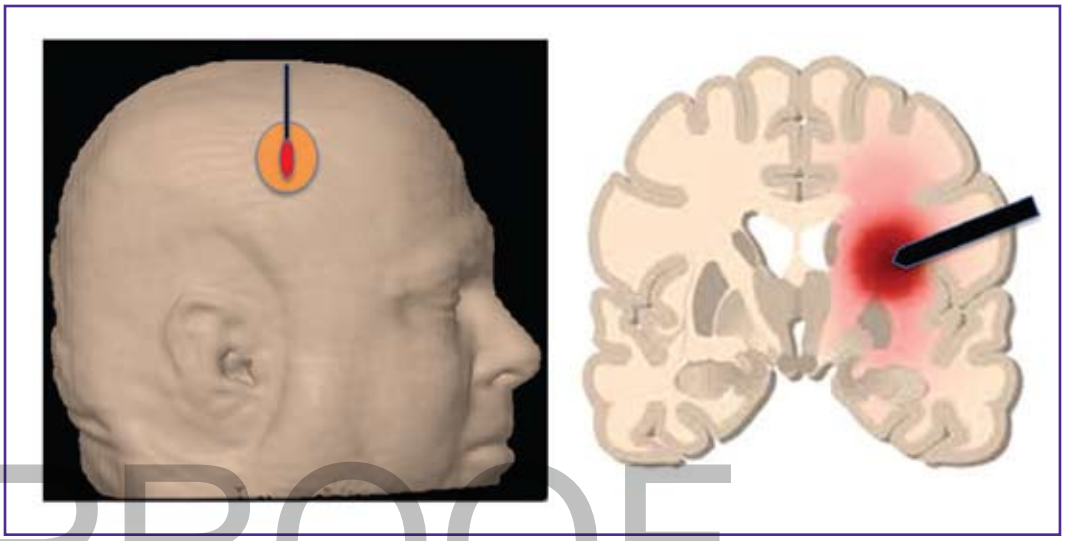
Stereotactic Laser Interstitial Thermal Therapy: A Minimally Invasive Innovative Approach for Difficult Brain Cancers

By Arnold B. Etame, MD, PhD

Surgery plays a major role in the management of brain cancers. Whenever the goal is solely for tissue-diagnosis, a stereotactic image-guided craniotomy for biopsy is often performed. However, in most cases the goals are surgery are centered on the principle of maximum-safe resection of tumors whenever feasible. There is also ample evidence within the cancer literature that local disease control in the brain is highly correlated with the extent of resection especially for tumors that primarily arise from the brain[1-5].



Stereotactic Laser Thermal Therapy for Brain Cancers

Safe resection of tumors is a paramount objective since any significant deficits that result from surgery could significant limit the patient's ability to proceed with adjuvant therapies such as chemotherapy and radiotherapy. Furthermore, tumors in eloquent or critical areas of the brain such as speech, motor, basal ganglia, thalamus and brainstem regions present unique challenges given the potential morbidity of surgery. Hence innovative strategies are warranted to minimize morbidity. Advances with awake-craniotomies[6-8] and image-guided navigational techniques[9-11] have made resection of tumors in motor and speech regions feasible with minimal adverse effects. Furthermore, innovative minimally invasive stereotactic-guided techniques such as Laser Interstitial Thermal Therapy (LITT) have demonstrated recent success in treating brain tumors that were once considered be in inoperable locations through traditional surgery[12].

Stereotactic LITT is a minimally invasive procedure whereby a laser fiber probe is used to focally destroy brain lesions with heat while sparing the surround normal brain[13]. Using the exquisite precision of image-guided navigation, the neurosurgeon can precisely target a tumor with a laser fiber probe placed to bisect the longest axes of the tumor (Figure 1). Placement of the laser fiber occurs in the operating room through a 3 mm bur-hole using a combination of high-resolution CT and MRI images for stereotactic localization of tumor and fiber placement. Next, the tumor ablation takes place under real-time MRI guidance using special software programs that provide real-time data on brain temperatures and zone of ablation. In order limit the extent of damage to surround brain tissue, the surgeon can place temperature threshold safeguard parameters which if realized in surrounding brain tissue, the laser would automatically shut off.

Stereotactic LITT is minimally invasive when compared to craniotomy resections. The procedure can be accomplished through a 4 mm skin incision, which minimizes blood loss, postoperative pain, discomfort and wound complications. Furthermore the precise and focal ablation minimizes damage to surround brain tissue making it ideal for tumors adjacent to critical structures. Expectedly, the recovery is markedly quicker with LITT compared to craniotomy with markedly lower complication rates and shorter hospital stay. Hence patients can quickly commence adjuvant therapies such as chemotherapy and radiotherapy.

The majority of LITT applications in Neuro-Oncology to date have been in the recurrent disease setting. LITT is effective for treating recurrent gliomas (glioblastoma) even in locations often considered inoperable[12, 14, 15]. Hence, LITT is emerging as a treatment paradigm for patients with thalamic glioblastomas. LITT is also effective for post-radiosurgery recurrence of brain metastases which minimizes interruption of systemic chemotherapy and other adjuvant therapies[16-19]. Such patients therefore experience very minimal interruption of systemic therapies when compared to craniotomy patients. Furthermore, LITT is effective for treating radiation necrosis [19-21] which is a post-radiotherapy inflamma-

tion associated with brain swelling and neurological symptoms.

Our Comprehensive Cancer Center is one of few centers in the US that currently offer LITT in the form of Visualase® for brain cancer treatment. We currently employ LITT for the treatment of glioblastoma, metastatic tumors, radiation necrosis, cancers in deep or critical locations that make conventional craniotomy surgery risky, and for patients with substantial medical comorbidities. Our outcomes have been thus far excellent in terms of successful ablation of lesions without significant neurological deficits. Patients are typically observed overnight and discharged the day after surgery. LITT serves a new treatment that provides hope to our brain cancer patients who would otherwise have no other treatment options.

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References available upon request

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