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## **History of Ablation Therapies in Neurosurgery** 193

Kristin Nosova, Esteban Quiceno, Amna Hussein, Oliver Bozinov, and Peter Nakaji

Laser interstitial thermal therapy (LITT) and high-intensity focused ultrasound thermal ablation (HIFU) are treatment options with great potential to treat glioblastoma, metastasis, epilepsy, essential tremor, and chronic pain. Results from recent studies show that LITT is a viable alternative to conventional surgical techniques in select patient populations. Although the bases for these treatments have existed since the 1930s, the most important advancement in these techniques has occurred in the last 15 years and the coming years hold much promise for these treatments.

## **The Evolution of Laser-Induced Thermal Therapy for the Treatment of Gliomas** 199

Purvee D. Patel, Nitesh V. Patel, and Shabbar F. Danish

Laser-induced thermal therapy (LITT) has evolved over the past two decades to treat a number of intracranial pathologies. Although it initially emerged as a salvage treatment of surgically inoperable tumors or recurrent lesions that had exhausted more conventional treatments, it is now being used as a primary, first-line treatment in certain instances with outcomes comparable to traditional surgical resection. The authors discuss the evolution of LITT in the treatment of gliomas and future directions, which may further enhance the efficacy of this procedure.


## **Laser Interstitial Thermal Therapy for Radionecrosis** 209

Alexis Paul Romain Terrapon, Marie Krüger, Thomas Hundsberger, Marian Christoph Neidert, and Oliver Bozinov

Radiotherapy is widely used for brain tumors but can cause radiation necrosis (RN). Laser interstitial thermal therapy (LITT) is a relatively new therapeutic modality for RN and its impact on patient outcome is still not well understood. Based on a systematic literature search (n=33), the authors discuss the available evidence. Most studies found a positive safety/efficacy profile, as LITT may help to lengthen survival, prevent progression, taper steroids, and improve neurological symptoms while remaining safe. Prospective studies on this subject are needed and may result in LITT becoming an essential therapeutic option for the treatment of RN.

## **Posterior Fossa Laser Interstitial Thermal Therapy in Children** 227

Giuseppe Mirone, Domenico Cicala, and Giuseppe Cinalli

 Video content accompanies this article at <http://www.neurosurgery.theclinics.com>.

Real-time, MRI-guided laser interstitial thermal therapy (MRgLITT) is emerging as a minimally invasive technique for epilepsy surgery and for deep-seated tumors in the pediatric population. However, MRgLITT for posterior fossa lesions poses a unique challenge that is especially evident in this age range and remains understudied. In

this study, we report our experience and analyze the current literature on MRgLITT for the treatment of posterior fossa in children.

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Silas Haahr Nielsen, Jane Skjøth-Rasmussen, Signe Delin Moldrup, Christina Malling Engelmann, Bo Jespersen, and Rune Rasmussen

MR-guided laser interstitial thermal therapy (LITT) is feasible and safe in the awake patient. Awake LITT may be performed with analgesics for head fixation in a head-ring, no sedation during laser ablation, and with continuous neurological testing in patients with brain tumors and epilepsy. In the LITT treatment of lesions near eloquent areas and subcortical fiber tracts, neurological function can potentially be preserved by monitoring the patient during laser ablation.

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Jamie J. Van Gompel, David B. Burkholder, Jonathon J. Parker, Sangeet S. Grewal, Erik H. Middlebrooks, Vance T. Lehman, Kai J. Miller, Eva C. Alden, and Timothy J. Kaufmann

Laser interstitial thermal therapy is an important new technique with a diverse use in epilepsy. This article gives an up-to-date evaluation of the current use of the technique within epilepsy, as well as provides some guidance to novice users appropriate clinical cases for its use.

### **Learning Curve Analysis and Adverse Events After Implementation of Neurosurgical Laser Ablation Treatment: A Population-Based Single-Institution Consecutive Series** 259

Margret Jensdottir, Ulrika Sandvik, Asgeir S. Jakola, Michael Fagerlund, Annika Kits, Klara Guðmundsdóttir, Sara Tabari, Tomas Majing, Alexander Fletcher-Sandersjö, Clark C. Chen, and Jiri Bartek Jr

A retrospective review of the first 30 patients treated with stereotactic laser ablation (SLA) at our institution since the introduction of the technique. We aimed to analyze initial results and learning curve. Indications were de novo gliomas (23%), recurrent gliomas (57%) and epileptogenic foci (20%). There was a trend towards improvement of lesion coverage and accuracy of catheter placement over time. Four patients (13.3%) experienced a new neurological deficit, where 3 patients had transient and 1 patient permanent deficits, respectively. Our results show a learning curve on precision measures over the first 30 cases.

### **Neurosurgical Applications of Magnetic Hyperthermia Therapy** 269

Daniel Rivera, Alexander J. Schupper, Alexandros Bouras, Maria Anastasiadou, Lawrence Kleinberg, Dara L. Kraitchman, Anilchandra Attaluri, Robert Ivkov, and Constantinos G. Hadjipanayis

Magnetic hyperthermia therapy (MHT) is a highly localized form of hyperthermia therapy (HT) that has been effective in treating various forms of cancer. Many clinical and preclinical studies have applied MHT to treat aggressive forms of brain cancer and assessed its role as a potential adjuvant to current therapies. Initial results show that MHT has a strong antitumor effect in animal studies and a positive association with overall survival in human glioma patients. Although MHT is a promising therapy

with the potential to be incorporated into the future treatment of brain cancer, significant advancement of current MHT technology is required.

### **Current Applications of Ablative Therapies for Trigeminal Neuralgia** **285**

Arpan R. Chakraborty, Kerrin Sunshine, Jonathan P. Miller, and Jennifer A. Sweet

Trigeminal neuralgia (TN) is a painful condition affecting the trigeminal nerve. The etiology of TN has not been definitively established but is thought to involve neurovascular compression of the trigeminal nerve at the trigeminal root entry zone. Patients who do not respond to medical management may benefit from focal injury to the trigeminal nerve. Many lesions have been described, targeting fibers of the trigeminal nerve at various anatomical locations across its course. This article reviews the relevant anatomy and lesioning procedures for the treatment of trigeminal neuralgia.

### **Pros and Cons of Ablation for Functional Neurosurgery in the Neurostimulation Age** **291**

Marwan Hariz

Should one recommend stereotactic ablation for Parkinson disease, tremor, dystonia, and obsessive compulsive disorder, in this era of DBS? The answer depends on several variables such as the symptoms to treat, the patient's preferences and expectations, the surgeons' competence and preference, the availability of financial means (by government health care, by private insurance), the geographical issues, and not least the current and dominating fashion at that particular time. Both ablation and stimulation can be either used alone or even combined (provided expertise in both of them) to treat various symptoms of movement and mind disorders.

### **High-Frequency Ultrasound Ablation in Neurosurgery** **301**

Jonathan Pomeraniec, W. Jeffrey Elias, and Shayan Moosa

Modern transcranial magnetic resonance-guided focused ultrasound is an incisionless, ablative treatment modality for a growing number of neurologic disorders. This procedure selectively destroys a targeted volume of cerebral tissue and relies on real-time MR thermography to monitor tissue temperatures. By focusing on a sub-millimeter target through a hemispheric phased array of transducers, ultrasound waves pass through the skull and avoid overheating and brain damage. High-intensity focused ultrasound techniques are increasingly used to create safe and effective stereotactic ablations for medication-refractory movement and other neurologic and psychiatric disorders.