Laser Interstitial Thermal Therapy

Coverage Policy

Laser Interstitial Thermal Therapy (LITT) is considered experimental, investigational or unproven for all indications.

Overview

This Coverage Policy addresses laser interstitial thermal therapy, also known as magnetic resonance-guided laser interstitial thermal therapy (MRgLITT). For interstitial laser coagulation of the prostate, see CP 0159 Benign Prostatic Hyperplasia (BPH) Treatments.

General Background

Laser interstitial thermal therapy (LITT) uses thermal energy to induce cell death by damaging DNA and causing protein denaturation. The goal of LITT is to achieve selective thermal injury of pathological tissue while maintaining a sharp thermal border between the tumor and normal brain tissues. LITT is one of several energy delivery methods using interstitial high heat to destroy tissue; another example is radiofrequency ablation (RFA). LITT has been explored since the late 1970s, but recent advances in probe design, cooling mechanisms, and real-time magnetic resonance (MR) thermography have increased interest in LITT.
LITT is also referred to as magnetic resonance-guided laser interstitial thermal therapy (MRgLITT), laser induced thermal therapy/thermotherapy, interstitial laser photocoagulation/coagulation, interstitial laser ablation, MRI-guided laser surgery, and MRI-guided percutaneous laser ablation.

LITT involves the creation of a small cranial bur hole, through which a thin laser fiber is introduced into the brain until the tip reaches the targeted location. After the probe is inserted in the operating room, the thermal ablation procedure is performed in the MRI suite. Thereafter, the patient is moved back into the operating room for probe removal. In real time, laser-induced temperature change is monitored by MR thermometry and correlated with predicted cell death by computer models. The workstation is located in the MRI control room. The surgeon controls the probe position inside the MRI and regulates ablation time and intensity on the workstation. Alternatively, the whole procedure could be performed under intraoperative MRI monitoring.

Benefits and Risks
The clinical indications for LITT are currently being defined. Ablation of deep-seated, eloquently situated primary and metastatic brain tumors, epileptogenic foci, and radiation necrosis are the majority of indications described in the literature.

Proposed benefits include providing a minimally invasive option for 1) treating surgically challenging tumors in locations that would otherwise have represented an intrinsic comorbidity by the approach itself, and 2) those with comorbidities that preclude open surgical procedures because of potentially high risks of morbidity and mortality. Surgical site infections, bleeding, and anesthesia-related risks are considered lower in LITT than those in open craniotomy.

Specific risks of LITT include damage to the cerebral vasculature by the laser probe which could result in hemorrhage or pseudoaneurysm that may require subsequent open or endovascular surgery. Although MR thermometry allows precise control of the ablated tissue, the risk of damage to the critical cortex areas and white matter tracts by the probe or thermal energy remains. Delayed transitory neurologic deficits due to increasing brain edema usually resolve after steroid therapy. Nonspecific adverse effects include balance disorder, dizziness, and headache. Brain abscess, seizures, and wound infection have also been reported. Risks and contraindications for MRI are also applicable to LITT. Other potential risks include variable skill level/technology learning curve. The exact rates of complications vary among patient populations and facilities. Neurosurgeons considering LITT must balance the potential benefits of surgical treatment with the risks of surgery in patients with comorbidities (Belykh, et al., 2017; Lagman, et al., 2017; Shukla, et al., 2017; Riordan, et al., 2014).

U.S. Food and Drug Administration (FDA)
LITT/MRgLITT is a procedure not subject to FDA regulation. There are numerous FDA-approved laser devices. On 04/25/2018, the FDA issued a FDA Alert on MR-Guided Laser Interstitial Thermal Therapy Devices with a letter to providers stating the FDA is currently evaluating data which suggests that potentially inaccurate MR thermometry information can be displayed during treatment. “For example, MR parameters such as voxel size (measurement of the image resolution or detail) and MR image acquisition time (e.g., up to 8 seconds) may contribute to inaccurate MR thermometry readings and potential errors in the ablation assessment. In addition, MRgLITT devices may not account for the continued thermal spread of energy to the surrounding tissue (as the target ablation area returns to its baseline temperature), which may result in an underestimation of thermal damage.”

The NeuroBlate® System (Monteris Medical, Plymouth, MN) and the Visualase® Thermal Therapy System (Medtronic Inc., Dublin, Ireland) are FDA-approved devices that are being used in LITT. Both systems can be used with intraoperative MRI, navigation or stereotactic systems, and provide predictive thermal dosage lines to estimate ablation volume.

Monteris NeuroBlate System: The NeuroBlate System is a collection of MRI-compatible laser devices and accessories that create an MRI guided delivery of precision thermal therapy in the practice of neurosurgery. Indications for use include:

• to ablate, necrotize, or coagulate soft tissue through interstitial irradiation or thermal therapy in medicine and surgery in the discipline of neurosurgery with 1064 nm lasers
• for planning and monitoring thermal therapies under MRI visualization. It provides MRI based trajectory planning assistance for the stereotaxic placement of MRI compatible (conditional) NeuroBlate™ Laser Delivery Probes. It also provides real time thermographic analysis of selected MRI images.

The Monteris Medical NeuroBlate probe, which is part of the NeuroBlate System, is under a Class I recall for potential unintended heating and patient injury (3/22/2018).

Visualase Thermal Therapy System: The Visualase Thermal Therapy System comprises four devices: a laser energy source, a cooled laser applicator, a pump for circulating coolant through the applicator, and a computer workstation with magnetic resonance imaging (MRI) analysis software for determination and visualization of relative changes in tissue temperature during therapy. Indications for use include:

• to necrotize or coagulate soft tissue through interstitial irradiation or thermal therapy under magnetic resonance imaging (MRI) guidance in medicine and surgery in cardiovascular thoracic surgery (excluding the heart and the vessels in the pericardial sac), dermatology, ear-nose-throat surgery, gastroenterology, general surgery, gynecology, head and neck surgery, neurosurgery, plastic surgery, orthopedics, pulmonology, radiology, and urology, for wavelengths 800nm through 1064nm.
• when therapy is performed under MRI guidance, and when data from compatible MRI sequences is available, the Visualase system can process images to determine relative changes in tissue temperature during therapy. The image data may be manipulated and viewed in a number of different ways and the values of data at certain selected points may be monitored and/or displayed over time.

Brain – Literature Review

The use of MR-guided LITT for treatment of benign and malignant brain tumors, intractable epilepsy, and radiation necrosis is evolving. The majority of studies are small, retrospective case series. A review of the current peer-reviewed literature reveals three areas of concern: 1) safety/adverse events, especially during technology learning curves 2) optimal patient populations are still being defined and 3) lack of long-term comparative prospective studies. The majority of studies reported in the literature are small retrospective case series and include patients who have failed other non-surgical and/or surgical treatment options or are not candidates for open surgery. Long-term comparative trials are needed to validate the safety of LITT and to define optimal patient selection.

A Hayes Health Technology Assessment on Laser Interstitial Thermal Therapy (LITT) for Treatment of Glioblastoma in Adults (September 20, 2019) gave a Hayes rating of D2 for use of laser interstitial thermal therapy (LITT) for the treatment of newly diagnosed, recurrent, or progressive glioblastoma (GBM) in adults. A very-low-quality body of evidence does not allow for conclusions to be drawn regarding the benefits and potential associated risks of LITT for the treatment of GBM. No comparative studies were identified. None of the studies presented evidence regarding the impact of LITT on quality of life (QOL). The patients within the eligible studies typically had GBM in difficult-to-access regions or had recurrent or progressive disease and were not amenable to standard surgical resection. Studies comparing LITT with standard treatment measures or historical patient groups are needed to ascertain the role of LITT in GBM.

The Canadian Agency for Drugs and Technologies in Health (CADTH) technology assessment on Laser Interstitial Thermal Therapy for Epilepsy and/or Brain Tumours (Williams, et al., 2019) notes that no comparative evidence on disease progression, overall survival, hospitalization, or quality of life was found. The evidence, drawn primarily from retrospective chart reviews, case series, and case reports, suggested that magnetic resonance-guided LITT proffers no advantage over stereotactic radiosurgery in reducing seizures in patients with drug-resistant, medically-intractable temporal lobe epilepsy (TLE). Also, relative to patients treated with SRS for medically-intractable TLE and craniotomy for high grade tumours in areas of eloquence, patients treated with LITT appeared to experience fewer adverse events and complications. None of the studies reported on the incidence of epileptic episodes, post-operative pain, use of medication, or hospital readmissions.

Xue et al. (2018) conducted a meta-analysis including 16 studies addressing 269 patients undergoing LITT for drug-resistant epilepsy. The authors noted the prevalence of Engel Class I (free from disabling seizures) after ablation were reported in 12 studies that included a total of 189 individuals. The pooled prevalence of patients who achieved postoperative freedom from epileptic seizures was 61%. Seven studies reported postoperative complications, with a total of 26 complications in 101 patients. The pooled prevalence was 24%.
Grewal et al. (2019) conducted a meta-analysis including 19 studies (total of 415 patients with medically intractable temporal lobe epilepsy). Of those studies, 9 were on LITT, with a total of 250 patients (60%), and 10 were on SRS, with a total of 165 patients (40%). The overall seizure freedom rate was comparable between the 2 procedures (LITT 50% vs. SRS 42%, p=0.39). Compared with SRS, LITT was associated with lower complication rates (LITT 20% vs. SRS 32%, p=0.06) but similar reoperation rates (15% vs. 27%, p=0.31).

In a retrospective review, Wu et al. (2019) reported on 234 patients with mesial temporal lobe epilepsy (mTLE) noting that at both 1 and 2 years after LITT, 58.0% achieved Engel I outcomes. A history of bilateral tonic-clonic seizures decreased chances of Engel I outcome. Ablations posterior to the lateral mesencephalic sulcus yields diminishing returns and has been associated with increased complications. The authors noted that further work is needed to further elucidate the nuances of ablation location and its impact on seizure and nonseizure outcomes.

Lagman et al. (2017) conducted a quantitative analysis of retrospective case reports and case series, evaluating results of 223 LITT patients (Visualase, n=154 [69%]; NeuroBlate n=69 [31%]). Epilepsy was the most common indication for Visualase therapy. There were no significant differences, except in age, wherein the NeuroBlate group was nearly twice as old as the Visualase group. The authors note that head-to-head comparison of these systems was difficult given the variance in indications (and therefore patient population) and disparate literature. They concluded LITT procedures have demonstrated effectiveness in the treatment of a variety of epilepsy etiologies and tumor pathologies but long-term outcomes have yet to be fully elucidated.

Kamath et al. (2017) retrospectively reported treatment of 120 patients (133 lesions) with LITT. There were several lesion types: glioblastomas (GBM, WHO grade IV glioma, n=57), metastases (n=25), WHO grade III gliomas (n=12), WHO grade II gliomas (n=12), epilepsy foci (n=11), WHO grade I gliomas (n=8), radiation necrosis (n=6), teratoma (n=1), and encephalocele (n=1). The NeuroBlate system was used. Median follow-up was 9.5 months with 18 patients lost to follow-up (15 GBM patients and three metastasis patients). The rate of complications/unexpected readmission was 6.0%, and the mortality rate was 2.2%. With high-grade tumors, tumor volumes >3 cm in diameter trended toward a higher rate of complication (p=0.056). Median progression-free survival (PFS) and overall survival (OS) for recurrent GBM were 7.4 and 11.6 months, respectively. As a frontline treatment for newly diagnosed GBM median PFS and OS were 5.9 and 11.4 months, respectively. For metastases, median PFS was not yet reached and OS was 17.2 months. There were eight perioperative complications (6.0%) and eight unplanned readmissions (6.0%). Of these there were three perioperative mortalities (2.2%). The authors noted interstitial laser ablation may offer a novel alternative to traditional open craniotomy in properly selected patients; further studies will be useful in guiding therapy.

Patel et al. (2016) published retrospective LITT data on 102 patients who required intervention for intracranial tumors (87 patients), chronic pain syndrome (cingulotomy, five patients), or epilepsy (ten patients). The procedure was completed in 98% (100) of these patients. The Visualase system was used. Ninety-two patients (90.2%) had undergone previous treatment for their intracranial tumors. There were 27 cases of morbidity, including new-onset neurological deficits, and two perioperative deaths. Fourteen patients (13.7%) developed new deficits after the LITT procedure, and of those 14 patients, 64.3% (n=9) had complete resolution of deficits within one month, 7.1% (n=1) had partial resolution of symptoms within one month, 14.3% (n=2) had not had resolution of symptoms at the most recent follow-up, and 14.3% (n=2) died without resolution of symptoms. The 30-day readmission rate was 5.6%. The authors concluded that LITT, although minimally invasive, must be used with caution. Thermal damage to critical and eloquent structures can occur despite MRI guidance. Once the learning curve was overcome, the overall procedural complication rate was low, and most patients were discharged within 24 hours, with a relatively low readmission rate. The author noted that the therapeutic role of LITT in various intracranial diseases will require larger and more rigorous studies.

Shah et al. (2019) retrospectively evaluated 91 patients with various diagnoses: dural-based lesions, ie, meningiomas (4%), intracranial metastases (45%), newly diagnosed glioblastoma (nGBM) (11%), recurrent glioblastoma (rGBM) (14%), and RN (20%). The remaining 6 LITT procedures were classified as “other”. Shah et al. reported 61% remain alive with 72% local control at median 7.2 months follow-up. Complication rate was 4%.
Sharma et al. (2016) reported retrospective case series results on 80 patients with tumor proximity to critical structures. High-grade glioma (n = 46) was the most common indication. Postoperative motor deficits (PMD) (partial or complete) were seen in 14 patients (11 with permanent and 3 with temporary PMDs).

Barnett et al. (2016) published a meta-analysis of retrospective and prospective studies which examined extent of resection (EOR) or extent of ablation (EOA) and major complications (defined as neurocognitive or functional complications which last >3 months duration after surgery) associated with either brain laser interstitial thermal therapy (LITT) or open craniotomy. Patients had high-grade primary or recurrent brain tumors (WHO grade III or IV) in or near areas of eloquence and/or of a deep-seated nature (e.g. brain stem). Websites for both Monteris Medical and Medtronic were searched for clinical studies associated with the NeuroBlate (Monteris) and Visualase (Medtronic). Eight studies on brain LITT (n = 79 patients) and 12 craniotomy studies (n = 1,036 patients) were identified which examined either/both EOR/EOA and complications. Meta-analysis demonstrated an EOA/EOR of 85.4 ± 10.6% with brain LITT versus 77.0 ± 40% with craniotomy (p= 0.01). Meta-analysis of proportions of major complications for each individual therapy demonstrated major complications of 5.7% and 13.8% for LITT and craniotomy, respectively. The authors stated that a statistically significant improvement in EOR/EOA along with a reduction in major neurocognitive complications appears to be possible with LITT versus craniotomy in patients with high-grade gliomas. A limitation of this meta-analysis is the inclusion of retrospective studies and the comparison of varying study protocols and populations to each other.

Curry et al. (2018) performed retrospective chart review of 71 patients with gelastic epilepsy related to hypothalamic hamartomas. Approximately 25% had failed other surgical or radiosurgical interventions prior to this trial. Results showed 93% of the patients were free of their gelastic seizures at one year, and 78% of the patients with less than a year of follow-up are free of gelastic seizures. There were 21 patients who had secondary seizures that were lessened by ablation and controlled with medicines, and 14 patients, 20%, required two ablations, and 2 patients required three ablations.

Bastos et al. (2019) reviewed results of 61 LITT patients with brain metastasis after stereotactic radiosurgery (SRS). There were 82 lesions (5 newly diagnosed, 46 recurrence, and 31 radiation necrosis). Freedom from local recurrence at 6 months was 69.6%, 59.4% at 12, and 54.7% at 18 and 24 mo. Complication rate was 26.2%.

Hernandez et al. (2018) performed a retrospective cohort study that used data from a prospectively accumulated database. LITT with the Visualase system was used to treat 59 patients with progressive enhancing inflammatory reaction (PEIR) that represents either tumor recurrence or radiation necrosis, or a combination of both, that occurred after radiosurgery for brain metastases. The median follow-up was 44.6 weeks. Local control rate was 83.1%. Most patients were weaned off steroids post-LITT. The authors propose offering LITT once PEIRs are identified and prior to the initiation of high-dose steroids for symptom relief.

In a retrospective series, Gadgil et al. (2019) reported on 58 hypothalamic hamartoma patients with gelastic seizures. With a minimum of 6 months of follow-up, 81% of patients were completely free of gelastic seizures at last follow-up. Of 22 patients with secondary nongelastic epilepsy, 15 were free of additional seizures. Authors report postoperative complication rate was low.

Gross et al. (2018) reviewed 58 patients with mesial temporal lobe epilepsy (mTLE), with or without mesial temporal sclerosis (MTS) who underwent LITT. At one-year following stereotactic laser amygdalohippocampotomy (SLAH), 53.4% of all patients were free of disabling seizures (Engel 1). Three of nine patients became seizure free following repeat ablation. Few procedure-related complications were observed.

Kamath et al. (2019) reported results of 54 glioblastoma (GBM) patients (58 LITT treatments, 41 were recurrent tumors while 17 were frontline treatments). Median overall survival after LITT for the total cohort was 11.5 months, and median progression free survival 6.6 months (Kamath, 2017; Hawasli, 2013).

Pruitt et al. (2017) reported retrospective results on 46 patients (CNS tumors n=13, radiation necrosis n=2, epilepsy n=31) who underwent 49 LITT procedures at one institution. The authors stated that the intent of the article was to “examine our experience with LITT, associated adverse events, and the lessons learned”. The Medtronic Visualase system was used. Some form of adverse event occurred in 11 (22.4%) of 49 procedures.
These included four catheter malpositions, three intracranial hemorrhages, three cases of neurological deficit related to thermal injury, and one technical malfunction resulting in an aborted procedure. Of these, direct thermal injury was the only cause of prolonged neurological morbidity and occurred in three of 49 procedures. Use of frameless stereotaxy and increased numbers of devices were associated with significantly increased complication rates (p < 0.05). The authors concluded LITT is a promising new tool for the treatment of patients with brain tumors and epilepsy. The authors stated “As is the case when adopting any new technology, a careful and honest evaluation of suboptimal circumstances will result in refinement of technique and improved clinical outcomes.”

Donos et al. (2018) retrospectively reviewed 43 patients with mesial temporal lobe epilepsy. After undergoing LITT, Engel class I surgical outcome was obtained in 79.5% and 67.4% of the 43 patients at 6 and 20.3 months of follow-up, respectively. No significant differences in surgical outcomes were found across patient subgroups (hemispheric dominance hippocampal sclerosis, or need for intracranial evaluation).

In a multicenter prospective Phase II trial, Ahluwalia et al. (2018) studied the results of laser interstitial thermal (LITT) ablation in 42 patients with radiographic progression after stereotactic radiosurgery for brain metastases. The NeuroBlate system was used. Patients had a Karnofsky Performance Scale (KPS) score ≥ 60, an age > 18 years, and metastatic disease from a known primary cancer type and were good surgical candidates. A total of 27 patients (64%) completed the 12 week follow-up, and 16 patients (38%) completed the full 26-week follow-up. Progression-free survival and OS rates were 74% (20/27) and 72%, respectively, at 26 weeks. There was a 12-week PFS and OS advantage for the radiation necrosis patients compared with the recurrent tumor or tumor progression patients.

Mohammadi et al. (2014) published retrospective LITT findings on 34 difficult-to-access high-grade glioma (DTA-HGG) (24 glioblastoma, 10 anaplastic) patients. Using the NeuroBlate system, 16 procedures (16 patients) were performed as upfront treatment for newly diagnosed HGG and 19 procedures (18 patients) were performed for treatment of recurrent disease. The median patient follow-up was 7.2 months. Overall 71% (25/35) of cases progressed during follow-up. The estimated median PFS for the cohort was 5.1 months. Any type of complication was observed after 13/35 LITT procedures (37%). The most common complication was a worsening of preoperative neurological deficit (usually motor) in seven (20%) cases. In five (14%) cases, the new deficit resolved within a few days; however, the new deficit was permanent in two (6%) cases. The authors proposed LITT can be used effectively for treatment of DTA-HGGs.

Hong et al. (2019) conducted a retrospective records review including 34 patients who underwent LITT. A total of 75 patients were reviewed; 42 patients had recurrent tumor (56%) and 33 (44%) had radiation necrosis (RN). Of patients with tumor, 26 underwent craniotomy and 16 LITT. For RN, 15 had craniotomy and 18 LITT. There was no significant difference between LITT and craniotomy in ability to taper off steroids or neurological outcomes. Progression-free survival (PFS) and overall survival (OS) were similar for LITT versus craniotomy, respectively: %PFS-survival at 1-year = 72.2% versus 61.1%, %PFS-survival at 2-years = 60.0% versus 61.1%, p = 0.72; %OS-survival at 1-year = 69.0% versus 69.3%, %OS-survival at 2-years = 56.6% versus 49.5%, p = 0.90. Craniotomy resulted in higher rates of pre-operative deficit improvement than LITT (p < 0.01).

Chaunzwa et al. (2018) reviewed MRI-guided laser thermal ablation (LTA) outcomes data for 30 patients across four centers who experienced radiosurgical failure following stereotactic radiosurgery for brain metastases attributed to tumor regrowth or radiation necrosis. All patients used the NeuroBlate system. A total of 73.3% of patients stopped steroids and 48% saw improvement of their preoperative symptoms. Overall survival rates after LTA were 52.3% at 6 months, 26.1% at 12 months, 21.8% at 18 months, and 16.3% at 30 months.

Youngermer et al. (2018) retrospectively reported selective laser amygdalohippocampotomy (SLAH) results in 30 patients; 12 had non-mesial temporal sclerosis (MTS) mesial temporal lobe epilepsy (MTLE) and 18 patients had MTS. All patients used the Visualase system and had at least 12 months follow-up. Nine patients had postoperative seizures, four within the first 24 hours of surgery, and an additional five within the first 14 days. The authors stated that postoperative seizures did not predict long-term seizure outcome. Five patients ultimately obtained seizure freedom and four did not. Engel class I seizure freedom was achieved in seven of 12 non-MTS patients (58%) and 10 of 18 MTS patients (56%), with no significant difference between groups (p=0.88). Three patients had procedural complications without long-term sequelae. The authors noted that
seizure-free rates are slightly lower than typically observed with surgical resection (60-80%); however, SLAH is less invasive than open surgery.

Le et al. (2018) reviewed 30 intractable mesial temporal lobe epilepsy (MTLE) patients who underwent selective amygdalohippocampotomy via LITT. Patients were prospectively tracked but retrospective data from telephone calls or chart reviews were also included. Median follow-up was 18±12 months. Results showed 28/29 (97%) patients had >50% reduction, and 22/29 (76%) patients had >90% reduction in seizure frequency. Engel Class I outcome was achieved in 18/29 (62%) patients; with complete seizure freedom in 9/29 (31%) patients (Engel Class IA). Complications included perioperative seizures in 10/29 (34%) and nonseizure complaints in 6/29 (21%) patients. Three (10%) patients had neurological deficits including one permanent superior quadrantanopsia.

Cajigas et al. (2019) reported results of 26 patients with treatment-resistant mesial temporal epilepsy who underwent LITT. After a mean follow-up time of 42.9 months, 61.5% (16/26) were free of disabling seizures, and 26.9% (7/26) had only rare disabling seizures. Postoperative complications occurred in 2 patients (7.7%), consisting of 1 permanent and 1 transient homonymous hemianopia.

Smith et al. (2016) evaluated 25 patients with biopsy-proven progressive neoplasms and post-radiation treatment effect (PRTE). Mean survival times (months) after LITT for grades 4 and 3 and for metastatic brain tumors were 13.1, 12.2, and 19.2, respectively. The SF-36 indicated significant overall effects on mental health (p=.029) and vitality (p=.005).

Salehi et al. (2018) reported on 24 patients with metastatic brain tumors who underwent LITT. Tumor types ranged from primary origin of lung (n = 16), melanoma (n = 3), followed by breast, colon, ovarian, and unknown primary. The majority of the lesions were frontal (n = 11) followed by parietal (n = 8) and other locations (n = 6). The mean follow-up period was 16.05 months. At the time of analysis, five (21%) patients were still alive, with a mean follow-up of 32.26 months. Median overall survival (OS) was 13.27 months.

Thomas 2016 reported on LITT in 21 glioblastoma (GBM) patients, 8 patients with newly diagnosed GBMs and 13 patients with recurrent GBM. Both Visualase and NeuroBlate systems were used. In the newly diagnosed GBM group, the median progression-free survival and the median survival after the procedure were 2 months and 8 months, respectively, and no patient demonstrated radiographic shrinkage of the tumor on follow-up imaging. In the 13 patients with recurrent GBM, 5 demonstrated a response to LITT, with radiographic shrinkage of the tumor following ablation. The median progression-free survival was 5 months, and the median survival was greater than 7 months.

Tao et al. (2018) prospectively assessed outcomes in 21 patients with medically refractory mesial temporal lobe epilepsy (mTLE) who underwent LITT. A Visualase system was used in performing combined stereo electroencephalography-guided and LITT. Of the 21 patients, 19 (90%) underwent invasive EEG study and 11 (52%) achieved freedom from disabling seizures with a mean duration of postoperative follow-up of 24±11 months after LITT. Eight (73%) of 11 patients with mesial temporal sclerosis (MTS) achieved freedom from disabling seizures, whereas 3 (30%) of 10 patients without MTS achieved freedom from disabling seizures.

Kang et al. (2016) prospectively tracked seizure outcome in 20 patients with drug-resistant mesial temporal lobe epilepsy (MTLE) who underwent LITT with the Visualase system. Two patients had mesial temporal lobe MRI lesions (one suspected low-grade glioma and one biopsy-proven low-grade glioma). Median follow-up was 13.4 months. The calculated proportion of patients free of seizures impairing consciousness (including those with auras only) was as follows: eight of 15 patients (53%) after six months, four of 11 patients (36.4%) after one year, three of five patients (60%) at two year follow-up. Four patients had an anterior temporal lobectomy (ATL) after LITT because of persistent seizures. The authors proposed that LITT is a safe alternative to ATL in patients with medically intractable mTLE. Individualized assessment is warranted to determine whether the reduced odds of seizure freedom are worth the reduction in risk, discomfort, and recovery time.

**Brain – UpToDate**

An UpToDate posting on delayed complications of cranial irradiation (Dietrich et al. 2020) notes under Brain tissue necrosis that in patients who do not achieve symptomatic response to glucocorticoids, or when
glucocorticoids cannot be tapered without return of symptoms, a variety of other treatment options have been explored, including bevacizumab and laser interstitial thermal therapy (LIIT). Under Summary, Dietrich et al. notes that surgical resection of the necrotic tissue is sometimes required, particularly in cases in which there is diagnostic uncertainty as to whether the radiographic changes are indicative of tumor progression or tissue necrosis, or in patients with severe necrosis who have contraindications to bevacizumab. Laser interstitial thermal therapy (LITT) is an option in this context but is less preferred in patients with preoperative neurologic deficits.

An UpToDate posting on the treatment of brain metastases (Loeffler et al. 2020) notes under ‘Recurrent disease’ section that local techniques, such as laser interstitial thermal therapy, are under investigation for recurrent brain metastases as well as radiation necrosis.

**Brain – Professional Societies/Organizations**


The Congress of Neurological Surgeons/American Association of Neurological Surgeons (CNS/AANS): The Guideline on the Role of Emerging and Investigational Therapies for the Treatment of Adults With Metastatic Brain Tumors (Chapter 9; Elder, et al., 2019) states “There is insufficient evidence to make a recommendation regarding the routine use of laser interstitial thermal therapy (LITT), aside from use as part of approved clinical trials. The CNS/AANS Guidelines on the Management of Patients with Vestibular Schwannoma (Chapter 9; Van Gompel, et al., 2018) and Guidelines for the Management of Progressive Glioblastoma do not address LITT (Olson, et al., 2014; Ryken, et al., 2014). The CNS/AANS guidelines do not address epilepsy.

The American Academy of Neurology (AAN) has several guidelines addressing epilepsy, none of which address LITT.

The American Epilepsy Society lists several Evidence-based Guidelines and Practice Parameters; none address laser interstitial thermal therapy.

The Epilepsy Foundation of America website includes Information For Professionals which addresses magnetic resonance-guided laser interstitial thermal therapy (MRgLITT). It states the best candidates for MRgLITT are patients with a well-defined epileptogenic focus. When focal seizures are uncontrolled by antiseizure drugs, a solitary lesion < 2 cm on high-resolution MRI of the brain and a concordant presurgical evaluation is the optimal preoperative situation for LITT.

**Breast – Literature Review**

Percutaneous treatments have been developed to reduce morbidity and improve esthetic results. A few studies have been published evaluating LITT of targeted nodules in malignant and benign breast disease. Most studies do not utilize the NeuroBlate or Visualase system. In a 2017 review, Fleming et al. suggests tumors larger than two cm do not appear to be good candidates for laser therapy, nor do those with an extensive in situ component. Although lasers can be placed under ultrasound or stereotactic guidance, the treatment zone is not well visualized, and MRI may be more useful in this regard. Conventional imaging techniques to explore breasts are x-ray and ultrasound (US). Kerbage et al. notes “specific and marginal indications require MRI (lobular cancer, young patients with dense breasts and undefined breast diseases, multifocal cancers). Thus, it appears that MRI is not the imaging to be privileged, even if MRI is used successfully to guide LITT in other organs.”

Mauri et al. (2016) conducted a meta-analysis of 45 studies, including 1,156 breast cancer patients and 1,168 lesions. Radiofrequency (n=577; 50%), microwaves (n=78; 7%), laser (n=227; 19%), cryoablation (n=156; 13%) and high-intensity focused ultrasound (HIFU, n=129; 11%) were used. The rate of technical success was defined as the rate of patients in whom the operator was able to technically complete the ablation procedure; technical efficacy was defined as the rate of lesions completely ablated. The reference standard for complete ablation was histopathology of the excised specimen or imaging follow-up. Differences between techniques were not significant for technical success (p=0.449), major complications (p=0.181) or minor complications (p=0.762), but significant for technique efficacy (p=0.009). Pooled technique efficacy was 75% (radiofrequency=82%; cryoablation=75%; laser=59%; HIFU=49%). The authors concluded that imaging-guided percutaneous ablation
techniques of breast cancer have a high rate of technical success, while technique efficacy remains suboptimal and complication rates are relatively low (6–8%).

Dowlatshahi et al. (2002) retrospectively studied 54 patients with mammographically-detected circumscribed breast cancers (50 invasive, four in-situ). A laser needle, wire localization, and stereotactic images were used. Each patient was treated with LITT prior to definitive surgical, radiation and if indicated, chemohormonal adjuvant therapy. Two patients opted for laser therapy without surgery. All patients subsequently underwent surgical removal of the laser-treated lesions one to eight weeks later to determine the rate of complete ablation. The overall success rate for complete tumor ablation was 70%. The authors state that interstitial laser therapy has the potential to change the paradigm for local treatment of mammographically detected well-defined breast cancers.

Basu et al. (1999) published a small prospective case series on 27 patients younger than 35 years who underwent laser phototherapy (interstitial laser hyperthermia) of their breast fibroadenomas. Lumps of more than one year in duration were selected. Under real-time ultrasound monitoring, Nd:YAG laser was used. Follow-up at eight weeks showed reduction in size in all although mild tenderness was still present. At eight weeks, 10 patients with residual lumps of more than one cm in diameter underwent excision biopsy with subsequent histopathological examination. There were minimal scars (2–3mm) and no keloid or abscess formation.

Breast – Professional Societies/Organizations
The American Society of Breast Surgeons (ASBS) Consensus Guideline on the Use of Transcutaneous and Percutaneous Methods for the Treatment of Benign and Malignant Tumors of the Breast notes ‘At this time, there are no FDA approved percutaneous or transcutaneous ablative treatments for breast cancer. At the present time, cryoaublation is approved for treatment of soft tissue malignancies. However, there is emerging data from clinical trials utilizing percutaneous ablative therapies for patients with early stage breast cancer without surgical excision. Techniques being evaluated include ablation by focused ultrasound, laser, cryotherapy, microwave, and radiofrequency’ (ASBS, 2018).

National Comprehensive Cancer Network® (NCCN®): The NCCN Breast Cancer guideline (2.2020) does not address LITT. The guideline addresses hyperthermia treatment (e.g., breast cancer of the chest wall). (See eviCore Radiation Therapy guideline).

Prostate
For Interstitial laser coagulation of the prostate, see CP 0159 Benign Prostatic Hyperplasia (BPH) Treatments.

Osteoid Osteoma – Literature Review
Gangi et al. (2007) retrospectively reported use of a diode laser to perform interstitial laser ablation (ILA) on 114 patients suspected of having osteoid osteoma. One week after ILA, 112 patients had a VAS pain score of zero. One week after ILA, one patient had pain that persisted for two months because of reflex sympathetic dystrophy. At follow-up (mean, 58.5 months), six patients had recurrence of pain from six weeks to 27 months after the initial ILA. These recurrences were treated successfully with a second ILA. Only one unsuccessful treatment was encountered. It is unclear what if any subset of patients from the Gangi et al. (2007) study is included in the Tsoumakidou et al. (2016) study. Tsoumakidou et al. (2016) used a diode laser with combined CT and fluoroscopic guidance in 57 spinal osteoid osteoma patients. OI was in the vertebral body for 18 of 57 patients, the neural arch for 21 of 57 patients, and the articular process for 18 of 57 patients. Primary clinical success at one month was 98.2%. Total recurrence rate was 5.3%. No major complications were noted.

Roqueplan et al (2010) reported using computed tomography (CT)-guided interstitial laser ablation (ILA) in 100 patients with osteoid osteoma. Results were retrospectively compared with 26 patients treated with percutaneous trephine resection (PR). The median follow-up for CT-guided ILA treated patients was 47 months. The clinical success rate was 96% at six-month and 94% at 24-month follow-up, with 4% (4/100) transient complications (one common fibular nerve contusion, one hematoma, one infection and one tendinitis). Four ILA procedures were repeated, one because of initial failure and three because of recurrence (at 6.5, 15 and 32 months). Two were successful and two failed again. In the group treated by PR, the clinical success rate was 96% at six-month and 95% at 24-month follow-up, with 12% (3/26) transient complications (one meralgia, two skin burns).
Fuchs et al. (2014) prospectively followed 35 osteoid osteoma patients treated with MRI-guided laser ablation for a mean time of 13.6 months. MRI follow-up demonstrated 28/35 patients (80%) showed a typical post-interventional target-like appearance of the ablated area, followed by a constant shrinking process along with a steady decrease in periablation changes such as peripheral bone edema. The authors stated that clinical success was achieved in 32/35 (91%).

**Osteoid Osteoma – Professional Societies/Organizations**

The National Comprehensive Cancer Network® (NCCN®) national guidance that is published for the treatment of bone cancer (1.2020) does not address laser interstitial thermal therapy.

American Academy of Orthopaedic Surgeons Clinical Practice Guidelines do not address osteoid osteoma.

**Other- Literature Review**

**Thyroid:** In a small randomized trial, Døssing et al. (2013) studied 44 patients with recurrent, benign (predominantly cystic) thyroid nodules who were randomized to a single aspiration with (n=22) or without (n=22) subsequent interstitial laser photocoagulation (ILP). A diode laser was used under US guidance. At six months follow-up results showed no significant difference between the group (p=0.001) in reduction of median total nodule volume. In the ILP group remission of the cystic part was obtained in 15 of 22 (68%) patients, compared with four of 22 (18%) patients treated with aspiration alone (p=0.002). The authors concluded that ILP compared to aspiration alone, for recurrent benign predominantly cystic thyroid nodules, increases the remission rate from 18–68%.

**Metastases:** Vogl et al. (2014) reported on 594 patients with colorectal cancer (CRC) liver metastases who underwent LITT. The median PFS was 13 months. The 1-, 2-, 3-, 4-, and 5-year PFS rates were 51.3%, 35.4%, 30.7%, 25.4%, and 22.3%, respectively.

Vogl et al. (2016) compared 109 patients with CRC lung metastases who have undergone ablation therapy performed using laser-induced thermotherapy (LITT, n=21), radiofrequency ablation (RFA, n=41), or microwave ablation (MWA, n=47). Follow-up visits occurring at 3, 6, 12, 18, and 24 months after ablation. The progression-free survival rate at 1, 2, 3, and 4 years was 96.8%, 52.7%, 24.0%, and 19.1%, respectively, for patients who underwent LITT; 77.3%, 50.2%, 30.8%, and 16.4%, respectively, for patients who underwent RFA; and 54.6%, 29.1%, 10.0%, and 1.0%, respectively, for patients who underwent MWA. The authors concluded there was no statistically significant difference noted among the three ablation methods.

Nour-Eldin et al. (2017) retrospectively compared laser-induced thermotherapy (LITT), radiofrequency ablation (RFA), and microwave ablation (MWA). A total of 175 computed tomography (CT)-guided ablation sessions were performed on 109 patients with surgically inoperable (non-colorectal cancer) pulmonary metastases who were poor candidates for surgery because of medical reasons including limited cardiopulmonary reserve, and had five or fewer lesions. Seventeen patients with 22 lesions underwent LITT treatment, 29 patients with 49 lesions underwent RFA, and 63 patients with 104 lesions underwent MWA treatment. Overall-survival rates showed no significant difference between LITT, RFA and MWA at log-rank test analysis (p=0.078). The 1- and 2-years of progression-free survival was 93.4 and 86.6% for MWA, 79.2 and 70.4% for LITT, and 89.4 and 68.2% for RFA. Statistically significant differences were seen in local tumour control and progression-free survival representing a potential advantage for MWA over RFA and LITT.

Tatsui et al. (2015) reported on 11 spinal metastasis patients with a high degree of epidural malignant compression due to radioresistant tumors who underwent spinal laser interstitial thermotherapy (SLITT) as an alternative to surgery. All patients received postoperative spinal stereotactic radiosurgery (SSRS). Median follow-up was 4.7 months. Imaging follow-up two months after the procedure demonstrated a significant reduction in the mean thickness of the epidural tumor from 8.82 mm before treatment to 6.36 mm after SLITT and SSRS (p=0.0001). The authors proposed this procedure can be an alternative to separation surgery in patients without neurological deficits prior to SSRS, especially in cases with progressive systemic disease, in which conventional surgery would pose a high risk for complications and lead to an interruption of or delays in the delivery of the intended oncological treatment.
Metastases – UpToDate
An UpToDate posting on nonsurgical local treatment strategies for colorectal cancer liver metastases (Venook et al. 2019) notes under ‘Tumor Ablation’ section that published experience with interstitial laser thermotherapy is limited to a few institutions. Venook et al. describes the Vogl et al. 2004 study.

An UpToDate posting on image-guided ablation of skeletal metastases (Kurup et al. 2017) notes under ‘Other emerging percutaneous techniques’ section that several additional thermal and non-thermal ablative techniques that are available to treat tumors in the liver, kidneys, and lungs have been applied to skeletal metastases in limited series. These technologies include microwave ablation, laser ablation (or laser interstitial thermal therapy), and irreversible electroporation.

The American Board of Internal Medicine’s (ABIM) Foundation Choosing Wisely® Initiative
No relevant information.

Centers for Medicare & Medicaid Services (CMS)
- National Coverage Determinations (NCDs): No applicable NCD found.
- Local Coverage Determinations (LCDs): No applicable LCD found.

Use Outside of the US
The European Association for Neuro-Oncology (EANO) has privately published guidelines.

Coding/Billing Information

Note: 1) This list of codes may not be all-inclusive.
2) Deleted codes and codes which are not effective at the time the service is rendered may not be eligible for reimbursement.

Considered Experimental/Investigational/Unproven:

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<th>CPT® Codes</th>
<th>Description</th>
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<tr>
<td>64999</td>
<td>Unlisted procedure, nervous system</td>
</tr>
</tbody>
</table>


References


5. American Association of Neurological Surgeons (See Congress of Neurological Surgeons.)


100. Williams D, Loshak H. Laser Interstitial Thermal Therapy for Epilepsy and/or Brain Tumours: A Review of Clinical Effectiveness and Cost-Effectiveness [Internet]. Ottawa (ON): Canadian Agency for Drugs and Technologies in Health; 2019 Jun. CADTH Rapid Response Reports.


