

# Current Treatments for Brain Tumors

Treatments for different brain tumors will depend on a patient's symptoms, location and grade of the tumor, the extent of possible surgical resection, and the tumor's biomarkers. Below is a general overview of most current treatment options available for patients with brain tumors. Always consult with your doctor concerning the most appropriate treatment options for you.

## SURGERY

Most treatment begins by assessing if a patient is eligible for surgery to remove as much of the tumor as possible without damaging critical healthy tissue. Neurosurgery and imaging technology, tools, and techniques have improved over the past decade, and many new advances are available to help surgeons remove or treat brain tumors with more precision and completeness. Patients should discuss their surgical options with their medical team, which may include:



- **Craniotomy:** A surgeon temporarily removes a section of the skull to access and remove as much of the tumor as safely possible.
- **Awake craniotomy:** The patient is awakened during surgery to perform tasks like speaking or moving, helping the surgeon map and protect critical brain functions.
- **Stereotactic needle biopsy:** Using 3D imaging for precision, a thin needle is guided through a tiny hole in the skull to extract a tissue sample.
- **Endoscopic or transsphenoidal surgery:** The surgeon reaches the tumor through the nose or a small incision using a thin tube with a camera (endoscope).

## LASER INTERSTITIAL THERMAL THERAPY (LITT)

LITT is a minimally invasive surgical procedure, guided by real time MRI, where a small incision is made, and a laser probe is inserted into the tumor to apply heat to damage and kill as many tumor cells

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as possible. During the procedure, the surgeon maps the treatment area using MRI-guided thermal imaging. The system provides continuous temperature updates, allowing the surgeon to track the treatment of the tumor in real time for maximum safety and accuracy. Also called laser ablation, it is often used to treat deep-seated tumors that are difficult to reach with traditional surgery. Medtronic's Visualase™ MRI-guided laser ablation, for example, is specifically indicated for use in brain metastases, high-grade gliomas, and radiation necrosis. Other FDA-approved LITT systems include NeuroBlate System and ClearPoint Prism Neuro Laser Therapy System.

## RADIATION THERAPY

Radiation therapy (also called “radiotherapy,” “irradiation,” or simply “radiation”) is another standard treatment that many patients with brain tumor will receive. Radiation therapy may involve the use of X-rays, gamma rays, neutrons, or protons to damage tumor cell DNA. Radiation may come from a machine outside the body (external-beam radiation therapy), or it may come from radioactive material placed in the body near tumor cells (internal radiation therapy or brachytherapy). Like surgery, there are now many newer and emerging radiation technologies, tools, and techniques, including radiosurgery (also called stereotactic radiosurgery) and proton beam therapy.



## CHEMOTHERAPY

Chemotherapy (often abbreviated as “chemo”) refers to chemical compounds — or drugs — that kill fast-dividing cells, like cancer cells. Chemotherapy can be provided to the patient in three forms: an oral drug, intravenously by IV injection, or as a wafer implanted during surgery.



A number of different chemotherapies are approved for use in brain tumors:

- **Temozolomide (or Temodar or TMZ):** An oral chemo drug most often prescribed to patients with high-grade gliomas.
- **Lomustine (CCNU):** An oral chemo drug frequently used in recurrent high-grade gliomas and in a three-drug combination called PCV, which also includes the chemotherapy drugs procarbazine and vincristine (Onocovin).
- **Carmustine (BCNU or BiCNU):** An intravenous chemo drug sometimes used in the treatment of high-grade gliomas. Carmustine also comes in the form of a chemotherapy wafer (Gliadel wafer) that is implanted into the tumor resection cavity during surgery.

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## TARGETED THERAPY (PRECISION MEDICINE)

Targeted therapy is a type of treatment that uses drugs to target the specific genetic and molecular alterations in tumors that drive their growth. Biomarker testing as part of obtaining a more comprehensive brain tumor diagnosis helps to identify which alterations to target. Some targeted therapies block the action of certain enzymes, proteins, or other molecules involved in the proliferation and spread of tumor cells. Targeted therapies may also be designed to hone in on and attack tumor cells specifically, causing less harm to normal cells. For brain tumors, there have been several targeted therapies approved and sometimes used in treatment:



- **Bevacizumab (Avastin):** An angiogenesis inhibitor that targets and blocks the VEGF protein, which prevents the growth of blood vessels that feed tumors. It is currently approved for patients 18 years and older for the treatment of recurrent glioblastoma.
- **Everolimus (Afinitor):** An mTOR inhibitor that targets and blocks the mTOR kinase protein, which is essential for tumor cell growth. It is approved for patients aged one year and older to treat a very rare brain tumor called subependymal giant cell astrocytoma (SEGA) associated with a condition known as tuberous sclerosis (TS).
- **Vorasidenib (Vorango):** An IDH1/IDH2 inhibitor that blocks abnormal IDH1 and IDH2 proteins that stop the tumor cells from maturing. It is approved for patients aged 12 years and older with grade 2 astrocytoma or oligodendroglioma.
- **Tovorafenib (Ojemda):** A type II RAF kinase inhibitor that targets the MAPK signaling pathway. It is approved for patients six months of age and older with recurrent or progressive low-grade gliomas with BRAF fusion, alteration, or V600 mutation.
- **Dabrafenib (Tafinlar) & Trametinib (Mekinist):** A BRAF and MEK inhibitor used together to block both BRAF and MEK signaling proteins that fuel tumor growth. It is approved for patients one year of age and older with newly diagnosed low-grade gliomas with BRAF V600E mutation.
- **Larotrectinib (Vitrakvi) and Entrectinib (Rozlytrek):** TRK inhibitors that target NTRK gene fusions that cause abnormal cell growth. These drugs are approved for patients aged one month and older with unresectable solid tumors that have an NTRK fusion.
- **Dordaviprone (Modeyso):** A protease inhibitor that helps to restore normal gene control within a cell. It is approved for patients one year of age and older to treat progressive diffuse midline gliomas with H3K27M gene alteration.

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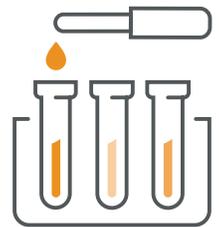
## TUMOR TREATING FIELDS

Tumor treating fields are a portable medical device (a wearable cap connected to a battery pack in a backpack) called “Optune Gio” that is placed on the scalp with electrodes and delivers alternating electric fields to disrupt tumor growth. This treatment is approved for use in newly diagnosed and recurrent glioblastoma patients.



## CLINICAL TRIALS

Clinical trials are controlled research studies that evaluate the safety, efficacy, and side effects of new drugs, medical devices, technologies, surgical techniques, or behavioral treatments. Many clinical trials evaluating novel treatments for brain tumors are ongoing. Clinical trials can be beneficial at various stages of treatment, including as a first-line option or alongside standard therapies. The National Comprehensive Cancer Network (NCCN) believes the best management of any patient with cancer is a clinical trial.

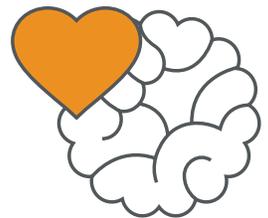


**Patients and caregivers can search for clinical trials using the NBTS Clinical Trial Finder:  
[BrainTumor.org/trials](https://www.brainumor.org/trials)**

## SUPPORTIVE CARE

To help manage side effects of the tumor and/or treatments administered, many patients are provided with the following:

- Anti-seizure/anti-epileptic medications to prevent or control seizures caused by a brain tumor
- Steroids to reduce brain swelling and inflammation
- Pain relievers
- Anti-nausea/antiemetic medications to reduce nausea



Additionally, some patients find benefit from other measures of palliative care, including certain diets, yoga, meditation, acupuncture, and other integrative or complementary therapies.