

AMERICAN BRAIN TUMOR ASSOCIATION

# Conventional Radiation Therapy



American  
Brain Tumor  
Association®

*Providing and pursuing answers®*

## ABOUT THE AMERICAN BRAIN TUMOR ASSOCIATION

Founded in 1973, the American Brain Tumor Association (ABTA) was the first national nonprofit organization dedicated solely to brain tumor research. The ABTA has since expanded our mission and now provides comprehensive resources to support the complex needs of brain tumor patients and caregivers, across all ages and tumor types, as well as the critical funding of research in the pursuit of breakthroughs in brain tumor diagnoses, treatments and care.

To learn more, visit [abta.org](https://www.abta.org).

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# Conventional Radiation Therapy

## INTRODUCTION

In general, current standard of care treatment options for benign (non-cancerous) and malignant (cancerous) brain tumors are surgery, radiation therapy, and in certain situations chemotherapy.

This brochure is about conventional external-beam radiation therapy (EBRT), for the treatment of primary and secondary (metastatic) brain tumors.

EBRT is the most common form of radiation treatment for brain tumors. EBRT is a method for delivering high-energy x-ray or electron beams directly to a tumor, designed to kill tumor cells, while protecting healthy cells and tissue.

## COMMON EBRT USES

Conventional external-beam radiation therapy (EBRT), is commonly recommended for the treatment of primary and secondary (metastatic) brain tumors.

It may also be used to prevent metastatic brain tumors from developing. This type of preventative therapy is called prophylactic radiation, and is most often used for patients diagnosed with small-cell lung cancer and certain blood cancers.

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If the tumor has spread to the spinal cord, or if there is a high risk of this type of spread, the spine might be irradiated as well.

In addition, EBRT is used to relieve symptoms in some cases rather than to eliminate the tumor. This is called **palliative radiation**.

## **GOALS OF EBRT**

The purpose of EBRT is to prevent, destroy or stop a brain tumor from growing.

Success depends on several factors: the type of tumor being treated (some are more sensitive to radiation than others) and the size of the tumor (smaller tumors are usually more responsive to treatment than larger ones).

Some tumors are so sensitive to radiation that EBRT therapy may be the only necessary treatment. Radiation can be used after a biopsy, or following partial or complete removal of a brain tumor. When a tumor is surgically removed, some microscopic tumor cells may remain. Radiation attempts to destroy these remaining tumor cells.

Before you or your family member begins radiation therapy, you will meet a doctor—a radiation oncologist—to discuss the options for therapy and plan the treatment. A radiation oncologist is a physician with advanced, specialized training in the use of radiation as a treatment for disease in any part of the body, including the brain. When you meet with the radiation oncologist, ask what the goals are for your treatment plan. It is also common to inquire as to the duration, in weeks, of the treatment course. This is also your opportunity to ask questions about the treatment itself so you understand the recommendations made by your radiation oncologist.

## HOW RADIATION WORKS

Conventional radiation therapy uses external beams of X-rays, gamma rays, protons or photons to directly destroy tumor cells or interfere with their ability to grow.

Radiation affects both normal cells and tumor cells. However, following standard doses of radiation, healthy cells repair themselves more quickly and completely than tumor cells. As the radiation treatments continue, an increasing number of tumor cells die. The tumor shrinks as the dead cells are broken down and disposed of by the immune system.

Like any organ in the body, normal brain tissue can tolerate only a certain amount of radiation. Different brain tumors require different amounts of radiation to cure or control them. Sometimes a form of local radiation may be used in addition to, or following, conventional radiation.

Radiation therapy may be given before or after chemotherapy, or with drugs that make tumor cells more sensitive to the radiation (radio sensitizers). This is becoming more common in the treatment of more aggressive brain tumors. In infants and young children, chemotherapy may be used to delay radiation therapy until the developing brain is more mature.

## TYPES OF CONVENTIONAL RADIATION

There are different conventional radiation methods. All methods deliver a precise amount of radiation to the tumor and limit the amount of radiation to nearby healthy brain tissue. Reducing radiation exposure could result in fewer side effects due to the treatment.

### Brachytherapy

Brachytherapy is a type of radiation therapy where the radiation source is placed directly within or near the tumor cavity. Targeted tile brachytherapy is a new type

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of radiation therapy FDA approved for malignant (cancerous) and recurrent brain tumors. One form of this therapy uses a flexible collagen tile containing radioactive sources. After a tumor has been surgically removed, the collagen tile is placed in the tumor cavity. This tile concentrates radiation toward brain tumor tissue with limited radiation to healthy tissue. As a result, targeted tile brachytherapy minimizes the side effects of radiation. Like other radiation therapies, targeted tile brachytherapy kills residual tumor cells. The tile delivers radiation until it is absorbed into the body, which usually takes about 100 days.

According to studies, this treatment led to a nearly doubled improvement in median tumor recurrence time. A form of surgically targeted tile brachytherapy was FDA approved in 2019 to treat patients with newly diagnosed malignant brain tumors and recurrent brain tumors.

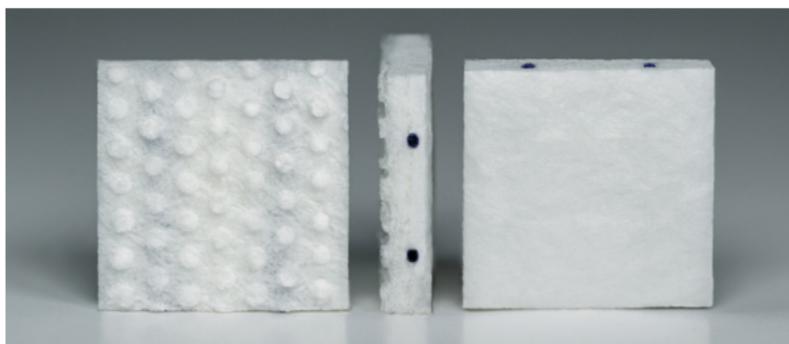


Image of GammaTile®, a Surgically Targeted Radiation Therapy.

## **Image Guided Radiation Therapy (IGRT)**

Image guided radiation therapy, simply means that images are taken each day prior to radiation therapy to make sure the radiation beams are focused on the tumor exactly and that exposure to normal tissues is limited.

## **Intensity Modulated Radiation Therapy (IMRT)**

Intensity modulated radiation therapy changes the strength of some of the radiation beams in certain

areas. This allows stronger doses to get to certain parts of the tumor and helps lessen damage to nearby normal body tissue.

### **Three-Dimensional Conformal Radiation Therapy (3D-CRT)**

Three-dimensional conformal radiation therapy is a procedure that uses a computer to create a 3-dimensional picture of the tumor. This method allows for the highest possible dose of radiation to be delivered to the tumor, while sparing the surrounding normal tissue as much as possible.

### **Proton Therapy**

Proton therapy is an advanced method for delivering radiation treatments to patients with brain tumors. It uses positively charged particles, known as protons, to send a high level of energy directly to the tumor site. A benefit of proton therapy is that it reduces the amount of radiation damage to healthy tissues as well as vital organs and structures near the brain tumor. While traveling toward the tumor site, proton beams release a much smaller amount of energy than other forms of radiation. Proton therapy is typically recommended for the treatment of tumors that are located in hard to reach areas or near vital organs and healthy brain tissue.

To learn more, read the ABTA's Proton Therapy brochure.

### **Stereotactic Radiosurgery (SRS)**

Stereotactic radiosurgery, also known as SRS, is an advanced form of radiation therapy that delivers precisely focused, high-dose radiation beams to treat the tumor. Despite its name, SRS is not a type of surgery.

SRS uses higher doses of radiation than conventional forms of radiation. It uses either photon or proton beams. These beams are so precise that the radiation is delivered to within one millimeter of the target.

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Additionally, these beams are designed to conform to the tumor's shape. These unique features help minimize the negative impact to surrounding healthy tissue and organs beyond the tumor. That, in turn, may result in fewer side effects of the treatment itself. This benefit is particularly important for young children, whose growth and development can be negatively affected by radiation therapy.

There are different technologies used to deliver SRS. Although the equipment or method varies, the goal is the same. SRS can be delivered using customized linear accelerators or approaches such as Gamma Knife®, CyberKnife® or proton-based delivery systems.

To learn more, read the ABTA's Stereotactic brochure.

### **Whole-Brain Radiation Therapy (WBRT)**

Whole-brain radiation therapy involves treating the entire brain with radiation and is most commonly recommended to treat metastatic brain tumors. When patients have tumors deep in the brain or many tumors throughout the brain, WBRT is often recommended. WBRT also is recommended for treating tumors that have spread throughout the brain, sometimes known as leptomeningeal disease.



Patient undergoing SRS therapy with Gamma Knife®.

To help protect cognitive function, it is recommended that patients receive a technically advanced form of WBRT known as intensity-modulated radiation therapy that avoids the hippocampus, an area of the brain that, when injured, is associated with cognitive decline. This advanced method of radiation has been shown in studies to better preserve brain function. Additionally, a drug called memantine has been shown to protect cognitive function from damage during WBRT.

Patients with a limited number of brain metastases are increasingly being treated with stereotactic radiosurgery (SRS), a highly targeted radiation therapy, as studies show it is associated with less cognitive decline than WBRT with no difference in survival.

## PREPARING FOR TREATMENT

First, the radiation oncologist will review your medical records, including the operative reports, pathology reports and imaging studies such as CT or MRI scans. The type and location of the tumor is determined from your records. The radiation oncologist then decides on the radiation target area and the amount of radiation that area should receive. The radiation oncologist will meet with you to discuss the treatment plan and expectations in detail.

The area to be irradiated usually includes the tumor and an area surrounding the tumor. This is because some brain tumors can have extensions, sometimes microscopic, into surrounding normal brain tissue.

To maximize the amount of radiation the tumor receives, and to avoid as much healthy tissue as possible, the radiation will be directed from several different angles. Computers are used to help shape and direct the radiation beams. The radiation oncologist will usually require a CT or MRI to assist with the treatment planning process and to confirm the target area.

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Once the decision to proceed with radiation has been made, one or two planning sessions, called **simulations**, are required. Each session will last approximately 30 minutes. You likely will be fitted for a face mask designed to help hold your head still, and specialized marks will be placed on the mask to ensure accurate and precise radiation delivery. On some occasions, a mask is not used, and marks will be placed on the skin.

Before your treatments begin, make sure to speak with your radiation oncologist to:

- Discuss the benefits and risks of the recommended treatment;
- Understand the potential side effects and make a plan to manage anticipated side effects; and
- Know whom to call during or after treatment if something unusual occurs between treatment sessions.



Patient receiving targeted radiation therapy while wearing a customized mask for head stabilization during treatment.

Before starting radiation, it's also important to let the radiation oncologist know about all the medications you are taking. Also, if you are using antioxidant vitamins or herbal supplements, bring the bottle(s) with you so the doctor can see the products and give you instructions about using them during radiation therapy.

## WHAT TO EXPECT DURING TREATMENT

Radiation therapy is usually given on an outpatient basis. Unless radiation is to be delivered to the spine, you won't have to remove or change your clothes for treatment.

The total procedure—checking into the radiation department, waiting your turn, and receiving treatment—should take between 10 and 20 minutes. The treatment itself takes just a few minutes.

The radiation session takes place in a specially designed room which houses the radiation machinery

(a linear accelerator or “linac”). The radiation equipment is very large. A certified radiation technologist, called a radiation therapist, will help you onto the table used for the treatment and position you. The radiation machine will then be directed to rest above, below or to the side of you. The table may move slowly from side to side while you are in the treatment room, but only under the expert guidance of the radiation therapist.

Your radiation therapist will leave the room prior to the actual treatment (just as the dentist does when X-raying your teeth). Don't worry, as you'll be seen and heard through a closed-circuit television monitor. Even though you seem to be alone, you're still in close contact. If you need help, just speak up.

Radiation treatments are painless and feel no different than getting a chest X-ray. While undergoing radiation therapy, a few people notice an unusual smell or see flashes of light even when their eyes are closed—this is normal. You will need to remain perfectly still until the session is over. Special equipment or medication can help infants and young children stay still.

During the treatment you may hear a gentle humming noise which is made by the radiation machine.

Sometimes, the radiation therapist will come in and out

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of the treatment room, usually to reposition you or the equipment.

A typical schedule for radiation therapy consists of one treatment per day, five days a week for two to seven weeks. However, treatment schedules may vary. Your doctor will explain your individualized schedule.

You are NOT radioactive during or after this type of radiation therapy. The radiation is active only while the machine is on. There is no need to take any special precautions for the safety of others.

## **MONITORING PROGRESS**

Tumor cells damaged by radiation cannot reproduce normally. Tumor cells that are unable to reproduce die over a period of weeks to months. During that time, the brain works to clear away those dead or dying tumor cells. This may cause swelling in the area of the tumor.

The best way to measure the effects of radiation is by a CT or MRI scan. An initial follow-up scan is usually planned for one to three months following treatment unless there is some reason to perform one sooner.

Scans taken during this time can be confusing because the dying or dead cells are often accompanied by brain swelling, resulting in the mass appearing larger than the original tumor when scanned. That mass may also cause symptoms similar to the original tumor.

If your post-treatment scans do not show shrinkage immediately, don't be disappointed. It often takes several months or more before your scans show the real results of treatment, and sometimes the scan does not look improved because the tumor is replaced by scar tissue.

Your symptoms may fade as your tumor shrinks. Sometimes they disappear completely. Some effects may continue even if your brain tumor is cured. Some

symptoms, whether related to the tumor or its treatments, may not resolve. Your doctor can discuss this possibility with you and create a plan to manage symptoms.



Patient entering MRI scan.

## COMMON SIDE EFFECTS

Most patients have some side effects from radiation therapy. The immediate or short-term effects tend to be manageable discomforts rather than pain or serious problems. Knowing about side effects in advance can help you plan for some temporary, but necessary, flexibility in your schedule.

### Fatigue

The most common side effect of radiation therapy is fatigue (tiredness). Fatigue is temporary. You may begin to feel unusually tired a few weeks into treatment, and this may last weeks or even several months after treatment has ended. Most patients feel run down or tired, but some become very fatigued. Speak with your doctor to discuss ways to manage and monitor fatigue.

- Make a plan to conserve your energy, but don't become inactive.
- Do what you must at the time of day you feel best.
- Ask family and neighbors to help with routine jobs such as laundry and grocery shopping.

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- Speak with your employer to discuss a modified work schedule (modified hours or remote work) while you are in treatment.
  - Plan easy meals using prepared foods or rely on frequent, nutritious snacks.
  - Incorporate a small amount of exercise (if approved by your doctor), which may increase your energy level.
  - Once you finish treatment, you'll probably begin feeling better, but be patient. You will generally feel much less tired a few weeks after the treatment is complete, but it can be a long time (as long as six months or more) before you feel "normal" again.

### **Hair Loss**

About two weeks into treatment you may start to lose the hair in the path of radiation beams. Hair loss is related to the amount of radiation, the area irradiated and the use of other treatments, such as chemotherapy. Your doctor can advise whether you will experience this effect, and if it is likely to be permanent or temporary.

If the loss is temporary, hair regrowth usually begins about two to three months following treatment, but may take six months to a year for maximum regrowth. A change of texture and/or change in the color of the re-growth may occur.

### **Skin Changes**

You may notice changes in your skin around the area being treated. After a few weeks of radiation, skin may be reddened, darkened, and itchy or appear "sunburned," this is called radiation dermatitis.

It's important not to scratch or rub these spots. If your ears are in the path of the radiation beams, they may

become sore and reddened inside and out. You may have difficulty with your hearing, due to fluid collecting in your middle ear.

Avoid anything that causes irritation to the area being irradiated. Do not use heating pads or ice packs during this time. Stay out of the direct sun, and keep your head covered if you have any skin problems or if you are taking a radio sensitizing drug.

Do not treat any of these symptoms by yourself. Ask your doctor or radiation oncologist for advice. Over-the-counter lotions can make the situation worse; use only products your doctors or nurses suggest.

### Swelling/Edema

Edema (brain swelling) is another common, usually temporary, side effect of radiation. The edema can cause an increase in your brain tumor symptoms. Edema may also cause seizures, so patients are monitored for this side effect throughout the course of their radiation therapy.

To help reduce edema, **steroids** may be given to you during, and possibly after, radiation.

Be sure to follow your doctor's exact instructions for taking steroids. Never abruptly discontinue steroid medications. When they are no longer needed, your doctor will give you instructions for "tapering" or slowly reducing, the medication. This process allows your body time to slowly begin making its own natural steroids again..

Often, your doctor will prescribe a medicine to prevent the stomach irritation which may occur with steroid use. Taking steroids with meals can also help reduce this side effect. Some people who take steroids experience a markedly increased appetite, along with weight gain, which often is most apparent in the face and abdomen. Your facial appearance and body shape will return to

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baseline once the steroids are discontinued, but it will take several months.

Nervousness or difficulty sleeping can be a side effect of steroids. Your doctor may prescribe a medication to calm you or help you sleep. Some people who take steroids develop a yeast infection in their mouth. If this occurs, you'll notice a sore mouth or throat, possibly with "fruity" smelling breath. Yeast infections are easily treated with medication.

People with (or prone toward) diabetes might experience an increase in their blood sugar level. If you begin to have excessive thirst with frequent urination—common symptoms of diabetes—let your doctor know immediately.

Also, people who take steroids for more than a month may notice a weakness in their legs. This may be noticed when they try to stand from a sitting position, or when they get up from the bed or the toilet. This symptom will disappear once the steroids are discontinued, although it may take several weeks to months for one's strength to completely return.

## **Nausea**

Sometimes people feel sick to their stomach following their radiation treatment, especially if they are receiving chemotherapy at the same time. There are medications, called **anti-emetics**, which help control nausea. These medicines are generally taken prior to, and sometimes after, radiation therapy. It's important to let your doctor or nurse know if you feel nauseated so they can help you manage this symptom. If for any reason the first anti-emetic medication does not work, call your doctor to let them know. Other medications or medication combinations can be tried until a treatment is found that works best for you.

Constipation can be a side effect of some of the common nausea medications, so be alert for changes

in your bowel habits. If you develop constipation, it is generally easy to control as long as it is not present for too long before starting radiation therapy.

While undergoing radiation therapy, your body may need extra protein and calories to keep your immune system healthy and to heal the effects of radiation. Ask your doctor for a referral to the dietician or nutritionist, to determine your personal nutrition needs, and help you with personalized dietary counseling. If you choose to look for nutrition services outside of the hospital, be sure to seek a licensed and registered professional.

### **Sexual Effects**

Desire for sexual activity may decrease as you undergo radiation therapy. This is a normal, and temporary, side effect of radiation therapy. The fatigue, as well as the conscious and unconscious stress associated with having a brain tumor, can cause this effect in both men and women. For now, try non-sexual closeness. Sexual desires often return to normal after therapy ends.

On the other hand, if you are taking steroids, don't be surprised if you experience an increase in sexual desire.

For women who are sexually active, it is best to speak with your doctor about conception while undergoing treatment.

### **Blood Clots**

For reasons that are not well understood, as many as one in three patients with a brain tumor may develop a blood clot. Most often, the blood clot develops in one leg, causing swelling of the foot, ankle and/or calf, usually with pain in the calf or behind the knee. If you develop these symptoms, call your doctor immediately. A special test called a Doppler study can be performed. If a blood clot is seen, blood thinners can be prescribed to dissolve the blood clot and prevent it from traveling into the lungs (known as a pulmonary embolism).

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Because patients who have a brain tumor tend to have blood clots more often than people who do not have a brain tumor, it is important that your doctor be aware of all the medications you are using. This includes over-the-counter drugs, herbs, vitamin supplements and complementary or alternative therapies. Filling your prescriptions at one pharmacy can also help avoid drug interactions that can make clotting problems worse.

### **Memory Changes**

It is not uncommon to have some change in memory, short-term in particular. If patients have some issues with memory, it is often short-term items such as what they had for lunch yesterday, or remembering the few items to buy at the grocery store.

Memory changes can be related to the tumor, surgery, chemotherapy or radiation. Fatigue also can play a role in decreasing memory and attention. Although the treatments themselves, including radiation, can have an impact on memory, tumor growth has the greatest risk to memory and other neurologic decline. While many patients' memory issues improve over time, some experience an increase in memory-related challenges.

### **Other Effects**

Radiation therapy may have intermediate and long-term effects. Information about those effects should be obtained from your doctor who can help you weigh the benefits of the treatment against the risks. If you have any questions, or notice any changes you think are important or worrisome, call your doctor or the radiation department at the hospital. Relieving symptoms and side effects, whether they are caused by the tumor itself or treatments, is an important part of the care plan for all patients with brain tumors.







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## AMERICAN BRAIN TUMOR ASSOCIATION INFORMATION, RESOURCES AND SUPPORT

### Brochures

Educational brochures are available on our website or can be requested in hard copy format for free by calling the ABTA. Most brochures are available in Spanish, with exceptions marked with an asterisk.

### General Information

About Brain Tumors: A Primer for Patients and Caregivers  
Brain Tumor Dictionary\*  
Brain Tumors Handbook for the Newly Diagnosed\*  
Caregiver Handbook\*

### Tumor Types

Ependymoma  
Glioblastoma and Anaplastic Astrocytoma  
Medulloblastoma  
Meningioma  
Metastatic Brain Tumors  
Oligodendroglioma and Oligoastrocytoma  
Pituitary Tumors

### Treatment

Chemotherapy  
Clinical Trials  
Conventional Radiation Therapy  
Proton Therapy  
Stereotactic Radiosurgery\*  
Steroids  
Surgery

## AMERICAN BRAIN TUMOR ASSOCIATION INFORMATION, RESOURCES AND SUPPORT

### Information

ABTA WEBSITE | [ABTA.ORG](http://ABTA.ORG)

Offers more than 200 pages of information, programs, support services and resources, including: brain tumor treatment center and support group locators, caregiver resources, research updates and tumor type and treatment information across all ages and tumor types.

### Education & Support

- **ABTA Educational Meetings & Webinars**  
In-person and virtual educational meetings led by nationally-recognized medical professionals.
- **ABTA Patient & Caregiver Mentor Support Program**  
Connect with a trained patient or caregiver mentor to help navigate a brain tumor diagnosis.
- **ABTA Connections Community**  
An online support and discussion community of more than 25,000 members.
- **ABTA CareLine**  
For personalized information and resources, call 800-886-ABTA (2282) or email [info@abta.org](mailto:info@abta.org) to connect with a CareLine staff member.

### Get Involved

- Join an ABTA fundraising event.
- Donate by visiting [abta.org/donate](http://abta.org/donate).

### Contact The ABTA

CareLine: 800-886-ABTA (2282)

Email: [info@abta.org](mailto:info@abta.org)

Website: [abta.org](http://abta.org)

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Email: [info@abta.org](mailto:info@abta.org)



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