Radiotherapy of the Brain (fractionated)

Overview

Radiotherapy uses high-energy rays to destroy tumors and other diseases. Radiation works by damaging the DNA inside cells and makes them unable to divide and grow. Radiotherapy uses low dose beams to treat the tumor and a margin of normal cells surrounding the target area to prevent tumor regrowth. The type and amount of radiation that you receive is carefully calculated during a number of therapy sessions. Over time, the abnormal cells die and the tumor shrinks. Normal healthy cells can also be temporarily damaged by radiation, but are able to repair themselves. The goal of radiotherapy is to maximize the damage to the tumor cells and minimize injury to normal cells.

What is fractionated radiotherapy?

The benefits of radiation are not immediate but occur with time. Aggressive tumors, whose cells divide rapidly, tend to respond quickly to radiation. Over time, the abnormal cells die and the tumor may shrink. Benign tumors, whose cells divide slowly, may take several months to show an effect.

Radiotherapy is split into a number of treatments called fractions that are given over several weeks. Delivering a small fraction of the total radiation dose allows time for normal cells to repair themselves between treatments, thereby reducing side effects. Fractions are usually given five days a week with a rest over the weekend. Therapy sessions often take less than an hour.

The radiation beams are generated by a machine called a linear accelerator. The beams are precisely shaped to match the tumor and are aimed from a variety of directions by rotating the machine around the patient (Fig. 1). There are several types of machines, but they all do the same things:

1. Precisely locate the target (tumor, lesion)
2. Hold the target still
3. Accurately aim the radiation beam
4. Shape the radiation beam to the target
5. Deliver a specific radiation dose

Doctors may recommend radiotherapy as a standalone treatment or in combination with surgery, chemotherapy or immunotherapy. Radiation may be given after surgery to stop the growth of tumor cells that remain. If eliminating the tumor is not possible, radiation can be used to relieve pain, seizures, or other symptoms.

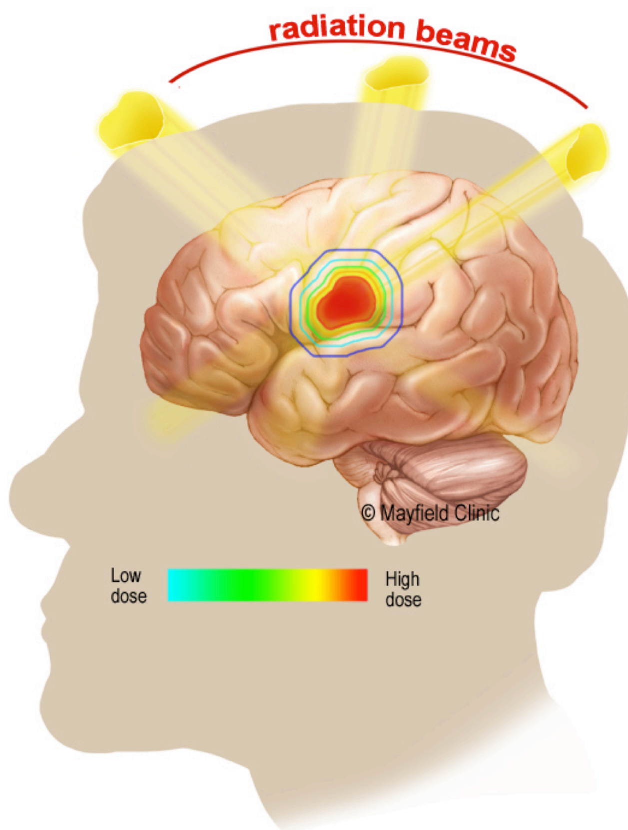

Figure 1. Radiotherapy shapes the radiation beam to match the outline of the tumor and includes a margin of normal brain to prevent recurrence. The beams come from many angles and intersect at the tumor to produce a high dose. The red ring shows the high dose and each outer ring represents lower and lower doses.

What's the difference?

RadioTHERAPY 6-33 fractions	Delivers radiation at lower doses, over multiple days, and to larger areas. Treats a "margin" of brain tissue around tumors.
RadioSURGERY 1-5 fractions	Delivers radiation at very high doses, a few times, to a small area. Benefit is its rapid fall-off giving a less dose to normal cells.

Who is a candidate?

You may undergo radiotherapy if you have a:

- Primary brain tumor: glioma, glioblastoma, astrocytoma, lymphoma
- Benign tumor: acoustic neuroma, pituitary adenoma, meningioma, craniopharyngioma, glomus tumor
- Metastatic tumor: lung, breast, skin, or other cancer that has spread to the brain

Who performs the procedure?

Radiation oncologists are doctors who have special training in treating cancer and other diseases with radiation. The radiation oncologist works with a team that includes a surgeon, medical physicist, dosimetrist, radiation therapist, and oncology nurse. The surgeon and radiation oncologist decide what techniques to use to deliver the prescribed dose. The physicist and the dosimetrist then make detailed calculations and set up the equipment. The radiation therapists position you on the machine and deliver the treatments. The nurse provides care and helps you manage any side effects.

What happens before treatment?

Consultation

Your first appointment is a consultation with a radiation oncologist. He or she will perform a physical exam and reconfirm your diagnosis based on the imaging studies (CT, MRI) and pathology reports. They will discuss with you the best type of radiation treatment for your particular tumor or lesion, explain the treatment process, and describe possible side effects. Once you've decided to go ahead with treatment, you will sign consent forms.

Step 1: create face mask

At your next appointment, a custom-made stereotactic mask will be made to fit your face exactly. It will be used during imaging and each treatment session to hold your head perfectly still. You will lie with your head on a cradle of mesh stretched between a U-shaped frame. Next, strips of stretchy plastic are placed across your forehead, under your nose, and over your chin. You will be asked to bite a small piece of plastic with your front teeth. Next, thermoplastic mesh is dipped into a water bath, making the mesh very flexible. The mesh is placed over the face and allowed to conform (Fig. 2). You will be able to easily breathe. Cold mitts help the mesh cool and harden. Creation of the mask takes about 30 minutes.

Step 2: simulation

Once the facemask is created you will undergo imaging scans, called a CT simulation, to carefully plan your radiation treatment. Reflective balls are placed on the facemask and worn during the CT scans (Fig. 3). These markers appear on the scan and help pinpoint the exact three-dimensional coordinates of the target within the brain. It may be necessary to obtain a new MRI scan.

After the scan, the facemask is removed and you may go home. The doctors continue with step 3 (treatment planning), and you will return within a week or so to begin treatment.

Step 3: treatment planning

Information about the tumor's location, size, and closeness to critical structures is gathered by the CT or MRI scan. Advanced computer software uses the scans to create a 3D view of your anatomy and the tumor (Fig. 4). Using the software, the radiation oncologist, surgeon, and physicist work as a team to determine the:

- appropriate target or targets
- radiation dose and number of treatments
- number and angle of treatment beams
- size and shape of the beams to exactly match the tumor or target

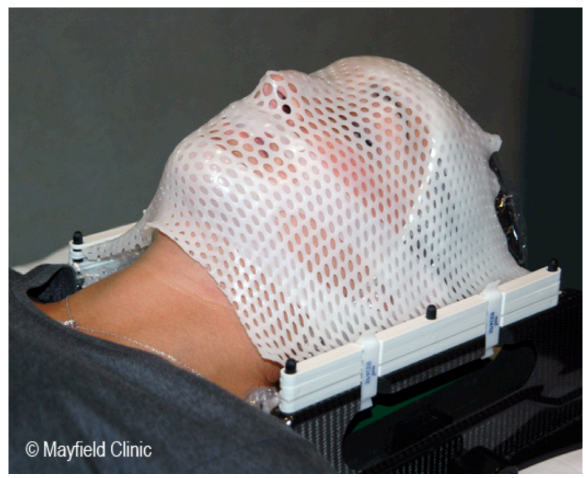

Figure 2. A thermoplastic mask is custom-fit to the contours of your face. The front and back pieces of mesh are secured to a U-shaped frame that attaches to the treatment table to hold the head still.

Figure 3. Reflective balls are placed on the facemask prior to CT scanning. Markers are seen on the CT scan and help pinpoint the exact coordinates of the tumor or lesion.

Each individual beam is too weak to damage the healthy brain as it passes through on its way to the target. But at the intersection of all the beams, the energy dose is strong enough to destroy the tumor.

What happens during treatment?

About a week after the simulation you will return to the center for your first treatment. The nurse or radiation therapist will escort you to a holding room, where you may need to change into a gown.

Step 4: position the patient

After the radiation machine is calibrated and prepared for your specific treatment plan, you will lie on the table. The mask is placed over your face and secured to the table. If you have a head frame, it is secured to the treatment table.

Alignment lasers and x-rays help to position you correctly. Stereoscopic x-rays are taken and compared to the treatment plan. Any misalignments are corrected before treatment.

Step 5: deliver the radiation

The therapist leaves the room and operates the machine from the control room. The team watches you through video monitors and speaks to you over an intercom. The machine and treatment table move every so often to deliver radiation beams from one or more directions (Fig. 5).

The machine is large and makes a humming noise as it moves around your head. Its size and motion may be intimidating at first. It may pass close to your body, but it will not touch you. You do not have to hold your breath—just breathe normally. Treatment may take 30 minutes or longer, depending on the complexity of the target.

What happens after treatment?

After treatment the therapist releases the facemask from the table and helps you get up. The facemask is stored at the center for your next session. You will return each day at your scheduled time to repeat steps 4 and 5 until all fractions of the complete dose are delivered.

Recovery and prevention

Side effects of radiation vary, depending on the tumor type, total radiation dose, size of the fractions, length of therapy, and amount of healthy tissue in the target area. Some side effects are temporary and some may be permanent. Ask your doctor about specific side effects you may experience. General side effects may include:

Fatigue

Fatigue is common. You may feel more tired than usual for a few weeks following treatment. Fatigue can continue for weeks or months after treatment stops. Save your energy for important obligations

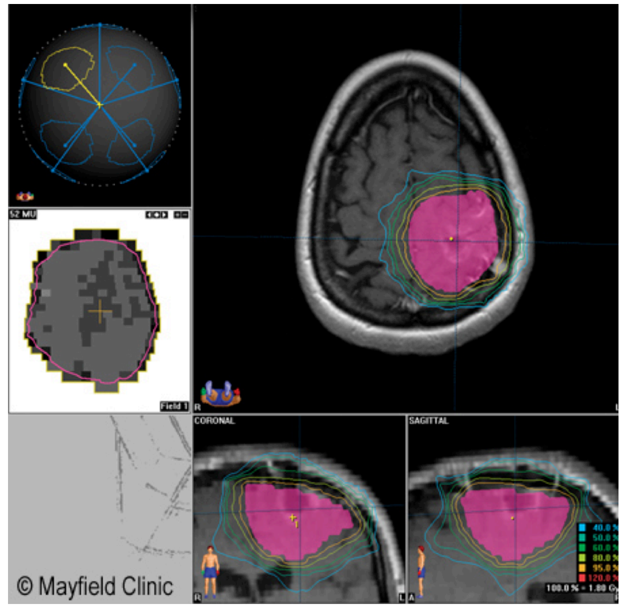

Figure 4. The computer creates a 3D view of your anatomy. A treatment plan determines the number and angle of beams, the size and shape of the radiation beams, and the radiation dose. The primary tumor area is pink with rings of lower doses around the margins.

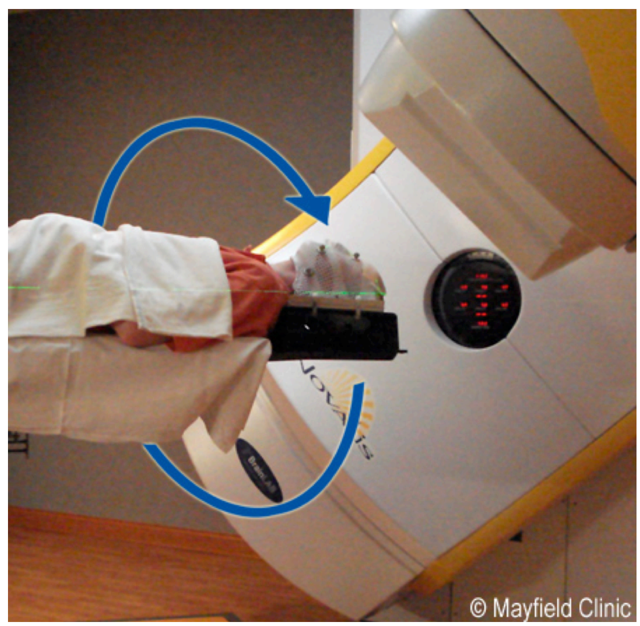

Figure 5. The facemask is secured to the treatment table and holds the patient's head perfectly still and positioned in the treatment field. The LINAC machine rotates around the patient, aiming radiation beams at the tumor.

and allow others to assist with chores or errands. Make sure you get plenty of sleep, take a nap after treatment, and eat a balanced diet. Some patients may need to increase their caloric and protein intake because their bodies are working hard to repair itself. Some patients may notice a lack of appetite and a loss of taste.

Exercise and/or stretching can also help you to combat fatigue. A short, brisk walk can be rejuvenating and can give you a boost.

Skin irritation
The skin at the areas where the radiation beams pass through may become slightly red and dry. This will go away after treatment stops. To prevent irritation, use mild soap when bathing. Apply lotion daily, immediately after a shower, to those areas exposed to radiation. Monitor your skin throughout the entire course of radiotherapy. Left untreated, skin irritation may lead to an infection.

Hair loss
You may experience hair loss in the treated area about two weeks after treatment begins. Hair will often grow back after treatment stops, though in some cases the regrowth may be incomplete. To prevent further hair loss, use a mild shampoo (not harsh or fragranced) when bathing. Soft hairbrushes and low heat while blow-drying will also help prevent further damage to your hair. Because areas exposed to radiation tend to sunburn easily, patients should protect those areas by applying sunscreen or wearing a wig, hat, or scarf.

Swelling (edema)
Radiation causes tumor cells to die. The body's natural response to cell death or injury is swelling. Edema is extra fluid, or swelling, within the tissues of the brain. If brain swelling occurs, it can cause headaches, weakness, seizures, confusion, or speech difficulty. It may also worsen the symptoms that were present before treatment. If you start to feel uncomfortable with headaches or any other symptoms, discuss this with your radiation oncologist. Steroid medication (dexamethasone) may be given to reduce brain swelling and fluid within the tumor. Steroids should always be taken with food to protect your stomach and prevent nausea. Steroids can also affect the normal bacteria in your mouth and cause a yeast infection called thrush – whitish patches on the tongue. Do not abruptly stop taking steroids. A tapering schedule is required to avoid withdrawal.

What are the risks?

Radiation necrosis
In rare cases, radiotherapy may cause the center of the tumor to become necrotic (dead). Radiation necrosis can happen anytime, but it most often occurs 6 to 12 months after radiotherapy. This dying tissue can become toxic to surrounding normal brain, and swelling may occur. Radiation necrosis may look similar to a regrowing tumor on an MRI scan. Special tests such as PET scan or MR spectroscopy/perfusion may help to tell between active tumor and necrosis. However, sometimes these tests are not definitive. Treatment for radiation necrosis may include:

- Medicines that reduce inflammation, 5-LOXIN (Boswellia serrata).
- Hyperbaric oxygen therapy (treatment in an oxygen chamber) may be prescribed to help damaged brain tissue heal.
- A drug called bevacizumab (Avastin) may be given if other treatments are not effective.
- In some cases, surgery may be needed to remove the necrotic tissue.

What are the results?

After all radiotherapy sessions are done, MRI scans will be taken periodically so that your doctors can look for signs of response. Several months may pass before the effects of treatment are visible. Some tumors may be completely eliminated with radiation. For other tumors, the goal is to stop or halt the growth. In some cases the tumor may not shrink, but still be considered "controlled."

Sources & links

If you have questions, please contact Springfield Neurological and Spine Institute at 417-885-3888.

Links
www.cancer.gov
www.abta.org

Glossary

benign: not cancerous.
fractionated: delivering the radiation dose over multiple sessions.
malignant: cancerous.
metastatic: a cancerous tumor that has spread from its original source.
stereotactic: a precise method for locating structures within the body through the use of 3-dimensional coordinates.
target: the area where radiation beams are aimed; usually a tumor or malformation.

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