

Radiation **Therapy**



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RADIATION THERAPY

A HANDBOOK FOR FAMILIES

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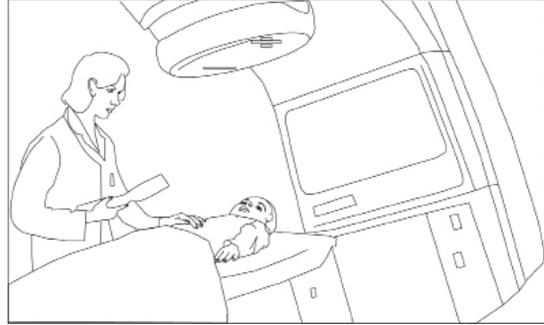
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■ WHAT IS RADIATION THERAPY?

Radiation therapy is the precise delivery of high-energy X rays (ionizing radiation) to kill cancer cells. Radiation therapy works by damaging the DNA (genetic make-up) of cancer cells. Cancer cells then are not able to repair themselves and subsequently die.

Radiation therapy can be used to treat many different types of cancer. About 40%–60% of all cancer patients will receive radiation therapy during the course of their illness.

It is used for solid tumors, including tumors of the brain, spinal cord, bone, and liver, as well as for cancers of the blood and lymphatic systems, such as leukemia and lymphoma. Radiation therapy can be used alone or in combination with surgery and/or chemotherapy. It also can be used in preparation for bone marrow transplant and as a curative treatment or palliative therapy when the goals of treatment are to improve quality of life and relieve symptoms such as pain, bleeding, and shortness of breath.



■ WILL MY CHILD BEGIN RADIATION THE FIRST DAY WE SEE THE RADIATION ONCOLOGIST?

There is a series of steps that need to be completed before radiation therapy can begin.

1. Consultation

A radiation oncologist is a physician who specializes in taking care of patients who need radiation therapy. During the initial consultation, you also may meet other members of the radiation oncology team. The radiation oncologist will examine your child and review his or her medical history, including X rays, lab tests, and pathology reports. The radiation oncology team will consult with your child's other oncologists about the best plan to treat your child.

During this visit, you will discuss the plan for treatment, including how long therapy will last and any potential side effects your child may experience. The amount of radiation needed and the duration of treatment will be determined by the radiation oncologist. For many types of cancer, the radiation dose is based on previous research. If your child is registered on a clinical trial, the dose will be based on the recommendations of the protocol. Treatment times can range from 1 day to several weeks. After you and your child have had an opportunity to ask questions, a plan for treatment will be developed. In general, you will be asked to give written permission for your child to begin treatment.

2. Simulation

Radiation therapy requires a planning session before treatment can begin. The initial planning session is also called a *CT simulation* or *simulation*. The simulation is usually performed in the radiation oncology department using computed tomography (CT), positron emission tomography (PET), or magnetic resonance imaging (MRI) scans of the area to be treated. During the scan, special immobilization equipment may be used to help your child remain still and in the same position throughout the course of treatment. Immobilization equipment and devices ensure that the radiation dose is delivered only to the intended

area. Depending on the area to be treated, immobilization equipment may include plastic, mesh masks that fit over the face; molds of the upper body, arm, or leg; bite blocks; or chin supports. Some children need sedation or anesthesia to help them remain still during the simulation and daily treatments. (Sedation or anesthesia also help to reduce fear or anxiety during the process.) The simulation process can last 1–2 hours.

3. Planning

The radiation oncologist creates a treatment plan that administers the maximum amount of radiation to the tumor while also protecting normal surrounding tissues. Planning can take several days from the time of the simulation to the day your child returns for treatment verification. During that time, the radiation oncologist and team are creating an individualized treatment plan based on your child's disease and specific requirements. No two treatment plans are exactly the same.

4. Treatment verification

After the treatment plan has been created, your child will need to visit the radiation oncology department for treatment verification. During treatment verification, your child will be placed in the proper treatment position with any necessary immobilization equipment or devices. The machine that delivers the radiation beam or linear accelerator will go through a final test to confirm the treatment plan is correct, and X rays will be taken to verify the treatment position. Treatment verification usually lasts less than an hour.

■ THE RADIATION ONCOLOGY TEAM

Your child's treatment is planned, administered, and monitored by a multidisciplinary team of healthcare providers.

Radiation oncologist

Radiation oncologists are physicians who have completed an additional 4 years of training in radiation oncology and 1 year of medical or surgical internship after medical school. Radiation oncologists have specialized training and knowledge related to the planning and delivery of all forms of radiation therapy. Most are certified by the American Board of Radiology. Please ask your doctor if he or she is board certified in radiation oncology.

Nurse practitioner

Nurse practitioners are registered nurses who have completed advanced education in nursing and are certified and licensed to practice as nurse practitioners in their state of employment. (In addition, nurse practitioners also may have received certification through the Association of Pediatric Hematology/Oncology Nurses [APHON] or the Oncology Nursing Society.) The nurse practitioner has additional training in radiation oncology and is able to help you and your child manage the side effects of radiation therapy.

Medical physicist

Medical physicists work with the radiation oncologist to develop and plan the arrangement of radiation beams. The medical physicist is responsible for quality control of the radiation oncology program as it relates to the procedures and machines and supervises the work of the dosimetrist.

Dosimetrist

Dosimetrists work with the radiation oncologist and medical physicist to develop the radiation therapy plan. The dosimetrist produces the planned arrangement of radiation beams from the radiation oncologist's specifications. The plan is reviewed and checked for accuracy and feasibility by the medical physicist.

Radiation therapist

Radiation therapists are licensed professionals who operate the radiation machine (also known as a linear accelerator) and deliver the correct dose of radiation as prescribed by the radiation oncologist. The radiation therapist works under the supervision of the radiation oncologist to ensure the treatment is followed exactly as planned.

Radiation oncology nurse

Radiation oncology nurses work with all members of the treatment team to develop a plan of care for your child. They help manage the side effects of treatment and provide education about the treatment regimen and possible side effects to you and your child. Radiation oncology nurses may initiate referrals to the nutritionist or social worker if needed during treatment.

Nutritionist

Nutritionists, or dieticians, provide information on the effects radiation therapy may have on your child's diet. They also will give you suggestions and guidance to help your child maintain his or her weight before, during, and after therapy.

Social worker

Social workers provide support to you and your child during treatment. This can include information about healthcare benefits, transportation, and counseling, as well as community and cancer support services.

■ TYPES OF RADIATION THERAPY

External beam radiation therapy (EBRT)

EBRT is radiation treatment from the outside delivered to a specific area of the body (e.g., leg, chest, brain). EBRT is delivered by a machine that uses photons (packets of energy) to make high-energy X rays. Multiple beams of radiation are produced in the radiation machine and then directed at the tumor. The beams are focused to deliver most of the radiation dose to the cancer cells while sparing the normal surrounding tissue. The treatment is usually painless and similar to the way X rays are taken. During EBRT, your child does not see, smell, or feel the treatment. Side effects generally are limited to the area of the body being treated.

EBRT is typically administered in small daily doses, Monday through Friday, during a period of several weeks. Your child's medical team will discuss the treatment schedule with you.

During the past 20 years, there have been many new types of radiation therapy discovered that help increase treatment of the tumor while decreasing damage to the surrounding areas.

THREE-DIMENSIONAL CONFORMAL RADIATION THERAPY (3D-CRT)

3D-CRT incorporates images from CT scans to make 3D pictures of the tumor and the areas around it. This allows the radiation oncologist and team to make the radiation beams match the shape of the tumor. When the beams are more precise, less normal tissue receives radiation, leading to fewer side effects.

INTENSITY MODULATED RADIATION THERAPY (IMRT)

IMRT divides radiation beams into beamlets. These beamlets can vary in intensity and allow the radiation oncologist to better aim the radiation and sculpt the dose more precisely around the target tumor. This leads to a stronger dose of radiation being delivered to the tumor and even less damage being done to healthy surrounding tissues.

IMAGE-GUIDED RADIATION THERAPY (IGRT)

IGRT is most appropriate for tumors that can move during treatment, such as tumors in the lung or liver. Small markers, called *fiducials*, are placed in or near the tumor before the planning CT scan to track the tumor's movement. Fiducials can be placed using CT or other image-guided needle punctures of the skin or by endoscopy or surgery. IGRT uses imaging such as CT scans, X rays, or ultrasounds taken just before daily treatment to check for any changes in the position of the patient or the tumor. These images are compared to CT scans taken during planning. Any difference between the planning films and daily imaging are corrected prior to each treatment.

Other forms of highly specialized external beam radiation include the following:

STEREOTACTIC RADIATION THERAPY

Stereotactic radiation therapy or stereotactic radiosurgery (SRS) delivers large doses of radiation in one large dose or in multiple smaller doses to a small area, usually in the brain or other parts of the body. The radiation beams are very precise and allow the radiation oncologist to protect more healthy tissue than other forms of EBRT. This treatment is appropriate only for certain types of cancer and is most commonly used for brain tumors. Stereotactic radiation therapy usually requires special equipment to help your child stay in the right position for the treatment.

INTRAOPERATIVE RADIATION THERAPY

Intraoperative radiation therapy involves delivery of radiation in the operating room directly to the tumor or tumor bed during surgery. This allows the radiation oncologist to clearly see the area to be treated and more precisely define the treatment field. Intraoperative radiation therapy also allows the radiation oncologist to deliver high doses of radiation therapy to the treatment site while protecting the nearby tissues and structures.

PROTON BEAM THERAPY

Proton beam therapy uses protons instead of photons as the energy source of radiation, resulting in less radiation to normal tissue around the tumor or targeted area. This treatment is usually reserved for tumors located in areas for which surgery is not an option and is also used when structures near the tumor may not be able to handle other types of radiation therapy. Proton beam therapy is typically used to treat tumors that are close to the surface of the skin. This treatment is only available at a few centers in the United States.

NEUTRON BEAM THERAPY

Neutron beam therapy is another form of EBRT used to treat tumors that do not respond to conventional radiation therapy using photons, because neutron beams may cause greater damage to tumor cells, halting the tumor growth. Neutron beam therapy also may be used in conjunction with chemotherapy and/or surgery to reduce the risk that the cancer will return or to remove small amounts of remaining cancer. Neutron therapy often takes fewer treatments than conventional radiation therapy; however, it is only available at a few centers in the United States.

TOTAL BODY IRRADIATION (TBI)

TBI is external beam radiation to the entire body in preparation for bone marrow (stem cell) transplantation. The goal of TBI is to suppress the immune system and kill any remaining cancer cells. TBI is usually performed 2 or 3 times each day for several days before the bone marrow transplant. Vital organs, such as the lungs, may be protected with lead shielding devices.

Brachytherapy

Brachytherapy is radiation that is given from inside the body. Radioactive material is sealed in a small container called an “implant” and placed into the area of the body to be treated. The implant may be permanent or temporary and can be placed in almost any cavity of the body in which the tumor is located, in the space left after the tumor is removed (surgical bed), or near the tumor itself. Brachytherapy allows the radiation oncologist to deliver higher doses of radiation to the tumor in a shorter amount of time than usual radiation. This may be done over several days or may be administered during a period of days to weeks.

Systemic radiotherapy

Systemic radiotherapy may be given as a pill or intravenously (IV) so that the radioactive material travels throughout the entire body. Some tumors, such as thyroid cancer, may be treated with systemic radiation. Newer treatments, such as radiolabeled antibodies, have radioactive particles attached to the antibody. An antibody is found in the blood or other body fluids and is used to identify and destroy foreign cells in the body. The antibody recognizes the cancer cells, attaches to them, and places small amounts of radiation into the cells, causing damage or death to the cancer cells.

■ DURING TREATMENT

Weekly on-treatment visits (status check)

Once treatment begins, your child will be monitored weekly by the radiation oncologist, resident, and/or nurse practitioner. These visits are intended to monitor how well your child is tolerating the treatment and are another opportunity for you to ask questions. During these visits, the area being treated will be examined, any side effects will be discussed, and a plan for managing them will be developed. The radiation oncologist may adjust the treatment schedule or radiation dose depending on how well your child is handling the therapy.



Weekly X rays (position verification)

X rays will be obtained at least weekly, usually every five treatments, and sometimes even daily during therapy. The X rays are reviewed by the radiation oncologist and therapist to verify the treatment position. Positioning is very important during radiation therapy because the tumor has been targeted down to the millimeter. Changes in position may affect which part of the tumor is receiving treatment. The X rays only look at position; they do not provide any information about the tumor's response to therapy.

■ FOLLOW-UP AFTER TREATMENT

When treatment is completed, your child will have a follow-up appointment with the radiation oncologist to monitor his or her recovery from treatment. Additional appointments will be scheduled as needed.

■ WILL MY CHILD BE RADIOACTIVE DURING TREATMENT?

If your child is receiving EBRT, he or she will not be radioactive. However, if your child is undergoing brachytherapy with permanent implants or systemic radiation therapy, he or she will be radioactive. Special precautions related to the care of your child while radioactive will be discussed before and after treatment.

■ WHAT ARE THE SIDE EFFECTS OF RADIATION THERAPY?

Most patients tolerate radiation therapy well. Side effects are not immediate and usually begin 2–3 weeks after treatment begins. Side effects may be mild at first and progress to moderate or severe. They can last for 2–3 weeks after radiation therapy has ended. Late side effects may occur months to years after treatment has ended. Because EBRT is a local treatment, side effects are only experienced in the area where the radiation was given. Side effects may be more severe when radiation therapy is used with chemotherapy or surgery.

Examples of radiation therapy side effects

Area Receiving Radiation	Side Effects During Treatment (acute effects)	Side Effects After Treatment (late effects)
Brain	Hair loss, dry scalp, darkening of scalp, nausea and vomiting, headaches	Decreased hormone production, potential for learning deficits, attention difficulties, hair loss
Head and Neck	Dry mouth, mouth sores, change in taste, difficulty swallowing and pain on swallowing, weight loss	Dry mouth, cavities, change in taste, decreased thyroid-hormone production, cataracts
Chest	Irritation of throat or esophagus (food pipe), heartburn, difficulty swallowing	Inflammation of lung and/or heart, lung fibrosis (stiffness of the lungs)
Abdomen and Pelvis	Nausea, vomiting, diarrhea, low blood counts	Inflammation of the bowel, sterility, bowel obstruction, early signs of menopause (e.g., vaginal itching, burning, and dryness; painful sexual intercourse; shrinking of vaginal tissues)
Bones and Limbs	Low blood counts	Decreased or incomplete bone growth, fractures
Skin	Irritation (similar to a sunburn), dry skin, hair loss	Darkening of the skin, slow wound healing, thickened skin
General	Feeling more tired than usual, sleeping more often	Secondary cancers

■ SHOULD I DO ANYTHING SPECIAL WHILE MY CHILD RECEIVES RADIATION THERAPY?

Skin care

Skin changes in the treatment area are very common. Skin may appear to have a mild sunburn, become darker in color, or even blister and peel. Good skin care is very important during radiation therapy. You should check the skin in the radiation area every day and notify your child's doctor or nurse about any changes. The skin in the radiation area should be cleansed with mild soap and warm (not hot) water; avoid scrubbing the skin. Your child's healthcare team will discuss with you how best to care for your child's skin during radiation. Special skin creams also may be provided. Skin care products, perfumes, and deodorants should not be used in the radiation area without first consulting your child's radiation team.

To prevent further skin breakdown in the radiation field, your child should avoid wearing harsh fabrics, such as wool or denim, tight-fitting clothes over the treatment area, and elastic bands or straps on the treatment area that may cause irritation.

Nutrition

Nutrition is extremely important during radiation therapy. Radiation therapy may cause your child to experience nausea and vomiting, mouth sores, or fatigue. These side effects may limit how much your child is able to eat and drink each day. The radiation oncologist, nurse, or nutritionist will discuss with you various ways to ensure your child receives adequate caloric and fluid intake. Your provider may prescribe anti-nausea medications for your child to take at home or prior to daily treatment.



Fatigue

Most children do well while on radiation therapy, but some may experience fatigue (feeling overly tired), especially later into treatment. Incorporating rest periods into your child's daily routine may be helpful.

■ HOW CAN I HELP MY CHILD DURING AND AFTER TREATMENT?

You have an important role in the care of your child, such as providing emotional support and maintaining your child's routine as much as possible. If your child feels well enough, have him or her attend school. Make every attempt to maintain your child's normal routine, but make allowances to accommodate if he or she feels ill.

For many parents and guardians, it may be difficult to see their child experience side effects. As a caregiver, you may need support during these times. Contact members of the treatment team, such as the nurse or social worker, for assistance. Remember to report any side effects to your child's radiation oncologist, nurse, or therapist. Your child's treatment team is there to help.



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