

## Linear Accelerator

*This information is reviewed by a physician with expertise in the area presented and is further reviewed by committees from the American College of Radiology (ACR) and the Radiological Society of North America (RSNA), comprising physicians with expertise in several radiologic areas.*

### What is this equipment used for?

A linear accelerator (LINAC) is the device most commonly used for external beam radiation treatments for patients with cancer. The linear accelerator can also be used in stereotactic radiosurgery similar to that achieved using the gamma knife on targets within the brain. The linear accelerator is used to treat all parts/organs of the body. It delivers a uniform dose of high-energy x-ray to the region of the patient's tumor. These x-rays can destroy the cancer cells while sparing the surrounding normal tissue. The LINAC is used to treat all body sites with cancer and used in not only external beam radiation therapy, but also for Stereotactic Radiosurgery and Stereotactic Body Radiotherapy.

A linear accelerator is also used for Intensity-Modulated Radiation Therapy (IMRT), Image Guided Radiation Therapy (IGRT), Stereotactic Radiosurgery (SRS) and Stereotactic Body Radio Therapy (SBRT).

### How does the equipment work?

The linear accelerator uses microwave technology (similar to that used for radar) to accelerate electrons in a part of the accelerator called the "wave guide", then allows these electrons to collide with a heavy metal target. As a result of the collisions, high-energy x-rays are produced from the target. These high energy x-rays will be directed to the patient's tumor and shaped as they exit the machine to conform to the shape of the patient's tumor. The beam may be shaped either by blocks that are placed in the head of the machine or by a multileaf collimator that is incorporated into the head of the machine. The beam comes out of a part of the accelerator called a gantry, which rotates around the patient. The patient lies on a moveable treatment couch and lasers are used to make sure the patient is in the proper position.

The treatment couch can move in many directions including up, down, right, left, in and out. Radiation can be delivered to the tumor from any angle by rotating the gantry and moving the treatment couch.



### Who operates this equipment?

The patient's radiation oncologist prescribes the appropriate treatment volume and dosage. The medical radiation physicist and the dosimetrist determine how to deliver the prescribed dose and calculate the amount of time it will take the accelerator to deliver that dose. Radiation therapists operate the linear accelerator and give patients their daily radiation treatments.

### How is safety ensured?

Patient safety is very important. During treatment the radiation therapist continuously watches the patient through a closed-circuit television monitor. There is also a microphone in the treatment room so that the patient can speak to the therapist if needed.

Port films (x-rays taken with the treatment beam) or other imaging tools are checked regularly to make sure that the beam position doesn't vary from the original plan.

The linear accelerator sits in a room with lead and concrete walls so that the high-energy x-rays are shielded. The radiation therapist must turn on the accelerator from outside the treatment room. Because the accelerator only gives off radiation when it is actually turned on, the risk of accidental exposure is extremely low. Indeed, pregnant women are allowed to operate linear accelerators.

Modern radiation machines have internal checking systems to provide further safety so that the machine will not turn on until all the treatment requirements prescribed by your physician are perfect. When all the checks match and are perfect, the machine will turn on to give your treatment.

Quality control of the linear accelerator is also very important. There are several systems built into the accelerator so that it won't deliver a higher dose than the radiation oncologist prescribed. Each morning before any patients are treated, the radiation therapist performs checks on the machine to ensure that it is working properly using a piece of equipment called a "tracker" to make sure that the radiation intensity is uniform across the beam. In addition, the radiation physicist makes more detailed weekly and monthly checks of the linear accelerator.

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