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## Linear Accelerator

### 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 is used to treat all parts/organs of the body. It delivers high-energy x-rays to the region of the patient's tumor. These x-ray treatments can be designed in such a way that they destroy the cancer cells while sparing the surrounding normal tissue. The LINAC is used to treat all body sites, using conventional techniques, Intensity-Modulated Radiation Therapy (IMRT) ([www.RadiologyInfo.org/en/info.cfm?pg=imrt](http://www.RadiologyInfo.org/en/info.cfm?pg=imrt)), Image Guided Radiation Therapy (IGRT) ([www.RadiologyInfo.org/en/info.cfm?pg=igrt](http://www.RadiologyInfo.org/en/info.cfm?pg=igrt)), Stereotactic Radiosurgery (SRS) and Stereotactic Body Radio Therapy (SBRT) ([www.RadiologyInfo.org/en/info.cfm?pg=stereotactic](http://www.RadiologyInfo.org/en/info.cfm?pg=stereotactic)).

### 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 are shaped as they exit the machine to conform to the shape of the patient's tumor and the customized beam is directed to 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 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. The beam comes out of a part of the accelerator called a gantry which can be rotated around the patient. 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 and is assured in several ways.

Before treatment is delivered to the patient, the treatment plan is developed and approved by the radiation oncologist in collaboration with the radiation dosimetrist and physicist. The plan is double-checked before treatment is given and quality-control procedures ensure that the treatment delivered is the same as was planned.

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

Modern linear accelerators also 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 provide your treatment.

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.

Safety of the staff operating the linear accelerator is also important. 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. The treatment room is shielded to such an extent that even pregnant women may safely operate linear accelerators.

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