

**CT
SCANS**

RADIOLOGY: THE ADVANCED MODALITIES

Computed Tomography (CT), Part One

How the Machine Works. Computed tomography, otherwise known as “CT” or “CAT scans,” is a more complex form of x-ray imaging. The basic principles are the same as in x-ray radiography (covered in Volume 1, Issue 1 of *The WCC Note*). In CT, x-ray radiation is transmitted through the patient. Denser tissues (such as bone or metal) don’t allow the radiation to go through the patient and reach the other side, while less dense tissues (such as air and fat) allow the radiation to travel completely through the body.



CT scanner: X-ray “in the round”

However, there is a detector instead of an x-ray plate or film on the other side of the patient. Also, in CT, x-rays are not only shot from one source – they come from all around the patient, like a circle of x-rays surrounding the patient’s body. The x-rays produced from one side of the patient go through the body or body part and hit a detector on the other side. Then the computer takes the information from each detector about how much radiation went through. Using complex mathematical formulas, the computer calculates how dense every tissue is within the area the CT scanner surrounds. It then makes a picture of the tissues or organs based on density, mapping very dense tissues (like bone or metal) as white, intermediate tissues (muscle, organs) as grey, and less dense tissues (air, fat) as black.

**WHY
CT?**



Chest X-ray

Why CT Scanning Revolutionized Medical Imaging

Before the invention of CT scanners, physicians relied on other modalities for medical imaging, including x-rays and ultrasound (both covered in previous issues).

X-ray radiography, although excellent for resolution, has the disadvantage that it does not allow us to determine the depth of the tissues on the image. For example, in a chest x-ray shot from front to back, the sternum, heart, lungs, ribs, and muscles all overlap each other, making it challenging to distinguish different substances.

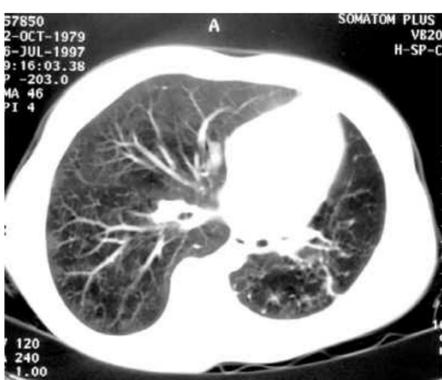
Within the abdomen, the muscles, stomach, liver, and pancreas all overlap each other and are similar in density, so they cannot be distinguished on traditional radiography. Today CT allows us to see different substances within the body without the overlap. By imaging “tomographic views,” meaning slices of the body, we can see each organ individually.

Ultrasound imaging does allow us to do this as well. Because ultrasound relies on sound waves rather than x-rays, however, the image resolution is poor and many areas of the body cannot be seen clearly.



Abdominal X-ray

**FASTER,
BETTER**



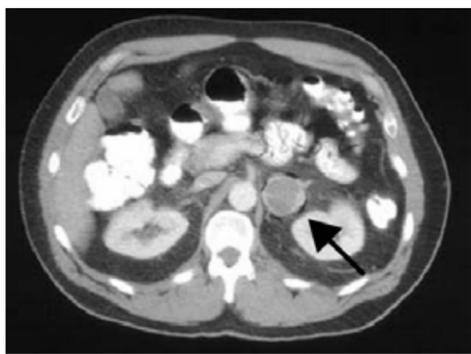
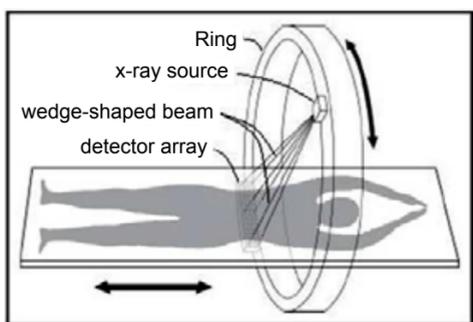
CT scan of the chest showing a small left hemithorax with small left lung

The Evolution of CT Scanning

The first CT scanner was invented by British scientist Sir Godfrey Newbold Hounsfield in 1973. Allan Mcleod Cormack of the United States had a similar idea, and the two of them received the Nobel Prize in 1979 for their work on computed tomography. Their work was funded by EMI, a diversified company best known for recording and distributing the music of The Beatles.

A CT scanner includes a component that resembles a big donut, called the “gantry”; the patient lies on a bed that moves through the gantry. As the patient moves through, the x-rays are shot out of the gantry into the center, where the patient’s body is. After that part of the body is done being imaged, the patient’s bed (the “table”) moves slightly so the next part of the body can be imaged.

As discussed above, the “detectors” are the parts of the CT machine that receive the x-rays transmitted through the patient’s body. Some of the earliest CT scanners had only a single detector ring; the table would stop at every “slice” of the patient’s body to allow the x-rays to be shot through the patient from every angle and the detector to get the information. One “slice,” or image, would take at least 30 seconds to a minute to complete. A CT of the brain, usually about 30 slices, would take almost half an hour.



Abdominal CT scan showing an enlarged adrenal gland

Today, a CT of the brain can be done in seconds. CT scans have gotten faster because:

- They have more detectors. The newer scanners have 64 rings of detectors, so many images can be obtained at the same time.
- CT images used to be obtained one slice at a time. Now, the gantry rotates 360 degrees around the patient in a spiral fashion at the same time as the table moves through it, which allows the scan to go faster. The computer then converts that data into slices.
- Wider x-ray beams in new scanners allow more of the patient to be imaged at one time.

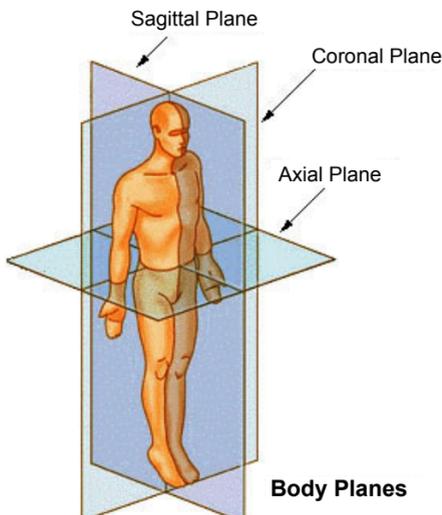
**IMAGING
PLANES**

Planes of Imaging

Computed tomography is traditionally performed in the axial, or transverse, plane. The axial plane is horizontal, slicing across the body as though one wanted to divide it into upper and lower parts. (When a magician pretends to saw his lovely assistant in half, he is cutting along the axial plane.)

Other imaging planes commonly used in CT are the coronal and sagittal planes. The coronal plane is vertical, dividing the body into front and back portions. The sagittal plane is also vertical, but divides the body into right and left parts. Oblique, or angled, planes also can be created in CT.

In the past, CT radiologists could take only axial images, then reconstruct them using a computer to view all these non-axial planes. Today, newer CT scanners with higher speed and resolution allow us to take images of the body in other planes directly.¹



NEXT WEEK: CT Imaging, Part Two

SOURCES

1. http://training.seer.cancer.gov/module_anatomy/unit1_3_terminology2_planes.html