# Computer tomography

Computer tomography is a medical imaging method which utilises X-rays to produce an image of the internal structure of the human body. These images produced are built up from tomographic slices of areas of the body. This procedure was 1st made sustainable commercially by Sir Geoffrey Hounsfield and his colleagues at EMI Central Research Laboratories in the United Kingdom in 1971.

## How it works

The basis of this CT scanning is that the patient to be scanned lies inside a vertical ring of X-ray detectors. As this ring remains stationary whilst the patient (who must also remain stationary) is exposed to a fan-shaped beam of X-rays which rotates around the body. The Imaging device divides the patient into a 3D network of squares each of which are called voxels, with each 2D plane of voxels known as a tomogram. The X-ray attenuation coefficient of the individual voxels, after the x-rays have passed through the patient is determined by the detectors opposite, and the electronic records are sent off to a computer. The computer generates the image of the internal structure of the human body by utilizing a Grey Scale v. X-ray attenuation coefficient graph. The higher the x-ray coefficient value of the voxel the greater the intensity of the pixel. The intensity value of each image pixel is placed on a monitor pixel, in the same order as their corresponding voxels. Hence a black and white image of the inside of the human body is produced. This image can be 2D or 3D. CT images are usually positioned such that it is as if we are looking up from the patient's feet. Left and right are reversed in the image produced.

## Diagnostic purposes of computed tomography

CT scanning is utilized in many ways in medicine. It has many diagnostic processes, for example it can be used instead of traditional X-ray imaging to show complex fractures (such as those around joints such as the knee, elbow or shoulder), ligament damage and dislocations. This is due to the ability of CT scanning to construct images of the site of the fracture in multiple planes.

Another use of CT is a method for diagnosis of abdominal ailments. It is an effective examination for investigation as to the cause of acute abdominal pain. Appendicitis, diverticulitis, renal stones, abdominal aortic aneurysm, pancreatitis and bowel obstructions are all conditions that can be readily identified and assessed using CT scanning. CT scanning is frequently used to ascertain the stage of cancers which originate in the abdomen and to follow their progress. Computed tomography is typically used for rapidly viewing brain injuries because it can reliably detect and determine the position of intracranial hematomas, oedema, brain contusions, infarctions, tumours, calcifications, haemorrhage and bone trauma. CT scanning can also be used to determine the extent of constriction in the coronary arteries.

## Advantages and disadvantages of computed tomography

CT scanning has advantages over conventional X-ray imaging. Firstly, CT scanning it overcomes the problem of superimposition of bones, organs etc. at different depths of the body, by taking several images of the site of interest from different angles. This, for example, makes it easier to distinguish bones of the front and back of the ribcage from each other. Secondly, unlike X-ray imaging, CT scanning shows up soft tissue on the image produced. This is particularly useful for detecting acute and chronic changes to the internal structure of the lungs or identifying pulmonary embolisms. Normal two-dimensional X-rays do not display such defects therefore, much less useful for diagnostic purposes.

There are a few side effects and disadvantages with CT scanning. The ionizing radiation applied on the body in CT scans (X-rays) is energetic enough to directly or indirectly damage DNA. If the DNA damage (change in order of bases on DNA strand) is not corrected properly by intracellular repair mechanisms then such damage may lead to cancer. The most common cancers caused by radiation exposure are lung, breast, thyroid and stomach cancer as well as leukaemia (Blood/Bone Marrow). This makes MRI Scanning, though it is more expensive and sensitive, safer as it does not expose the patient to ionising radiation as it is dependent on a static magnetic field which causes hydrogen nuclei in the body to align with the field and low energy electromagnetic radiation. Another disadvantage of CT scanning compared to traditional X-raying techniques is time taken to generate a scan. Normal 2D X-ray imaging generates images in a couple of minutes (3-4 minutes) whilst CT imaging takes quite a lot of time in comparison (15 minutes to 1 Hour).

CT scans involve the use intravenously injected iodine or barium based radiocontrast agents such as barium sulphate. These contrast agents are used to improve the visibility soft tissue (intestines, blood vessels etc.) on X-ray imaging techniques. These agents can possibly cause minor reactions such as nausea, vomiting and an itching rash. However, more severe reactions may occur such as anaphylaxis or acute renal failure.

Dilute barium sulfate has the benefits over other contrast agents, because it doesn’t cause kidney damage or allergic reactions. However, it can’t be used in patients with bowel injuries, because seepage of the barium sulfate can lead to fatal peritonitis (inflammation of the lining of the inner wall of the abdomen).

## Links