



# NSI

The NeuroScience Institute

Neurological Tests & Treatments

## What Is SPECT?

The "age of nuclear medicine" has created new and safer ways to treat people suffering from disease and injury.

What is SPECT? It is an acronym for Single Photon Emission Computerized Tomography. It is a sophisticated nuclear medicine study that looks directly at cerebral blood flow and indirectly at brain activity (or metabolism). In this study, a radioactive isotope (which, as we will see, is akin to a myriad of beacons of energy or light) is bound to a substance that is readily taken up by the cells in the brain.

The camera has special crystals that detect where the compound (signaled by the radioisotope acting like a beacon of light) has gone. A supercomputer then reconstructs 3-D images of brain activity levels. The elegant brain snapshots that result offer a sophisticated blood flow/ metabolism brain map. With these maps, physicians have been able to identify certain patterns of brain activity that correlate with psychiatric and neurological illnesses.

SPECT studies belong to a branch of medicine called nuclear medicine. Nuclear (refers to the nucleus of an unstable or radioactive atom) medicine uses radioactively tagged compounds (radiopharmaceuticals), because the unstable atoms emit gamma rays when they decay acting like a beacon of energy or light from each location where they go. An unstable atom is always looking for stability, and it will keep changing or degrading, until it reaches its most stable form. At each step of decay, it emits a gamma ray (portion of energy). Scientists can detect those gamma rays with film or special crystals and can record an accumulation of the number of beacons that have decayed in each area of the brain. These unstable atoms are essentially tracking devices – they track which cells were most active and had the most blood flow and those cells which are least active and have the least blood flow.

Nuclear medicine studies measure the physiological functioning of the body, and they can be used to diagnose a multitude of medical conditions: heart disease, certain forms of infection, the spread of cancer, and bone and thyroid disease. My own area of expertise in nuclear medicine, the brain, uses SPECT studies to help in the diagnosis of head trauma, dementia, atypical or unresponsive mood disorders, strokes, seizures, the impact of drug abuse on brain function and atypical or unresponsive aggressive behavior.

During the late 70s and 80s SPECT studies were being replaced in many cases by the sophisticated anatomical CAT and later MRI studies. The resolution of those studies was far superior to SPECT as far as seeing tumors, cysts and blood clots. In fact, they nearly eliminated the use of SPECT studies altogether. Yet despite their clarity, CAT scans and MRIs could offer only images of a static brain, and its anatomy; they gave little or no information on the activity in a working brain. It was analogous to looking at the parts of a car's

engine without being able to turn it on. In the last decade it has become increasingly recognized that many neurological and psychiatric disorders are not disorders of the brain's anatomy, **but** problems in how it functions.

Two technological advancements have encouraged the use, once again, of SPECT studies. Initially, the SPECT cameras were single-headed, and they took a long time to scan a person's brain (up to an hour). People had trouble holding still that long, and the images were fuzzy, hard to read (earning nuclear medicine the nickname "unclear medicine") and they did not give much information about the functioning deep within the brain. Then multi-headed cameras were developed which were able to image the brain much faster and with enhanced resolution. The advancement of computer technology also allowed for improved data acquisition from the multi-headed systems. The brain SPECT studies of today, with their higher resolution, can see into the deeper areas of the brain with far greater clarity and show what CAT scans and MRIs cannot – how the brain actually functions.

