# CLASS III & IV

27 Jan 2017

# Camera Head

- contains a disk-shaped (mostly on older cameras) or rectangular thallium-activated sodium iodide [NaI(Tl)] crystal, typically 0.95 cm ( 3/8 inch) thick, optically coupled to a large number (typically 37 to 91) of 5.1- to 7.6-cm (2- to 3-inch) diameter photomultiplier tubes (PMTs)

**FLOWCHART**

- Photons are absorbed in the sodium iodide crystal, causing the emission of visible light and ultraviolet (UV) radiation.

- The light and UV photons are converted into electrical signals and amplified by the PMTs

- These signals are further amplified by the preamplifiers (preamps).

- The amplitude of the electrical pulse produced by each PMT is proportional to the amount of light it received following an x- or gamma-ray interaction in the crystal.

# Single Photon Emission Computed Tomography

- nuclear medicine tomographic imaging technique using gamma rays
- The technique requires delivery of a gamma-emitting radioisotope (a radionuclide) into the patient, normally through injection into the bloodstream.
- radioisotope is a simple soluble dissolved ion, such as an isotope of gallium(III) ( inflammation, a marker for many disease states), Iodine
- radioisotope is attached to a specific ligand to create a radioligand, whose properties bind it to certain types of tissues.
- SPECT scan monitors level of biological activity at each place in the 3-D region analyzed.

# Single Photon Emission Computed Tomography

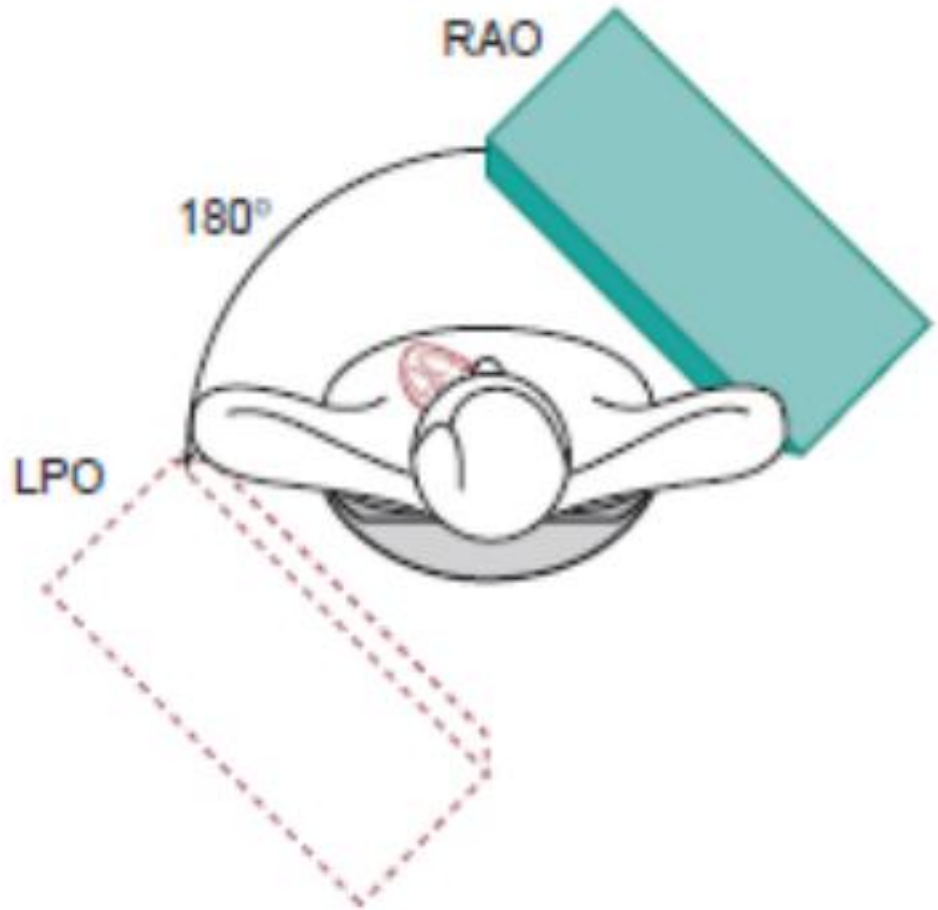
- generates transverse images depicting the distribution of x- or gamma-ray–emitting nuclides in patients.

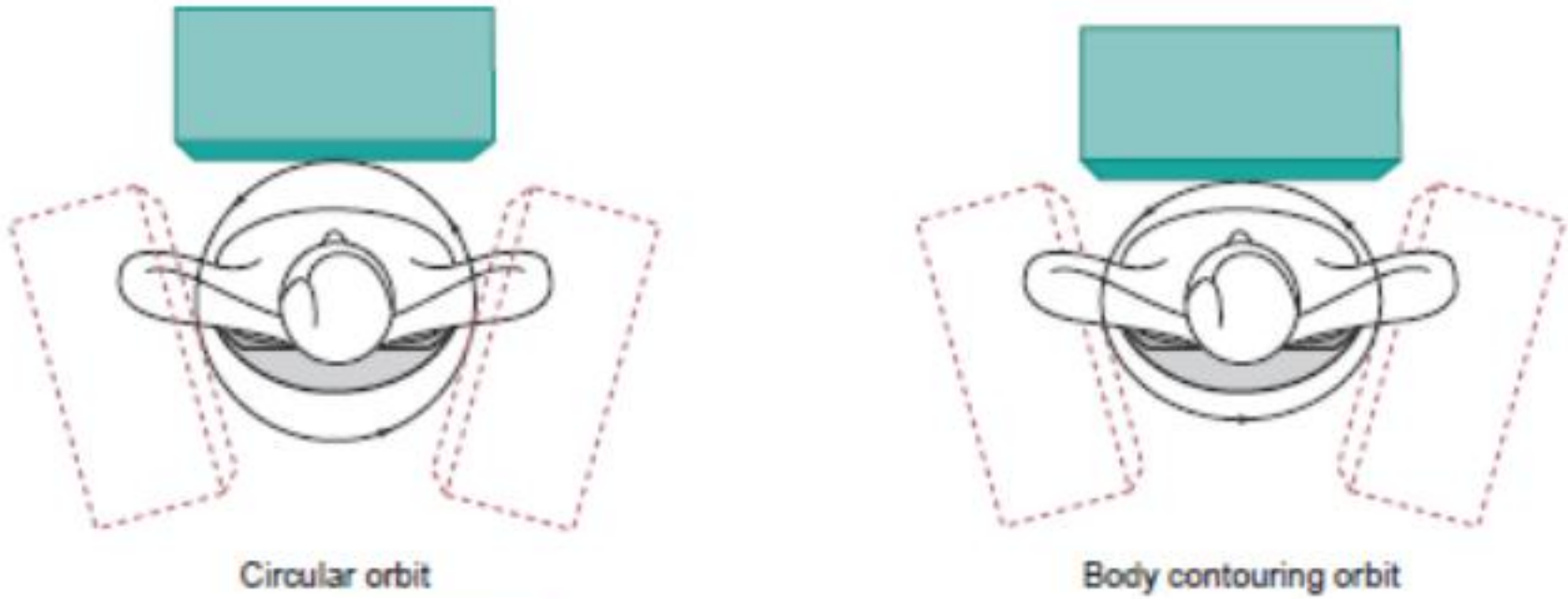
- Standard planar projection images are acquired from an arc of 180 degrees (most cardiac SPECT)

- SPECT system's digital computer then reconstructs the transverse images using either **filtered backprojection** or an **iterative reconstruction method**

- FLOWCHART
  - The camera head or heads of a SPECT system revolve about the patient, acquiring projection images.
  - “Continuous” acquisition vs “Step and Shoot” acquisition
- SPECT projection images are usually acquired in either a $64^2$ or a $128^2$ pixel format.
- Using too few projections creates radial streak artifacts in the reconstructed transverse images. (CT Matlab Code)

LPO: Left Posterior Oblique
RAO: Right Anterior Oblique.





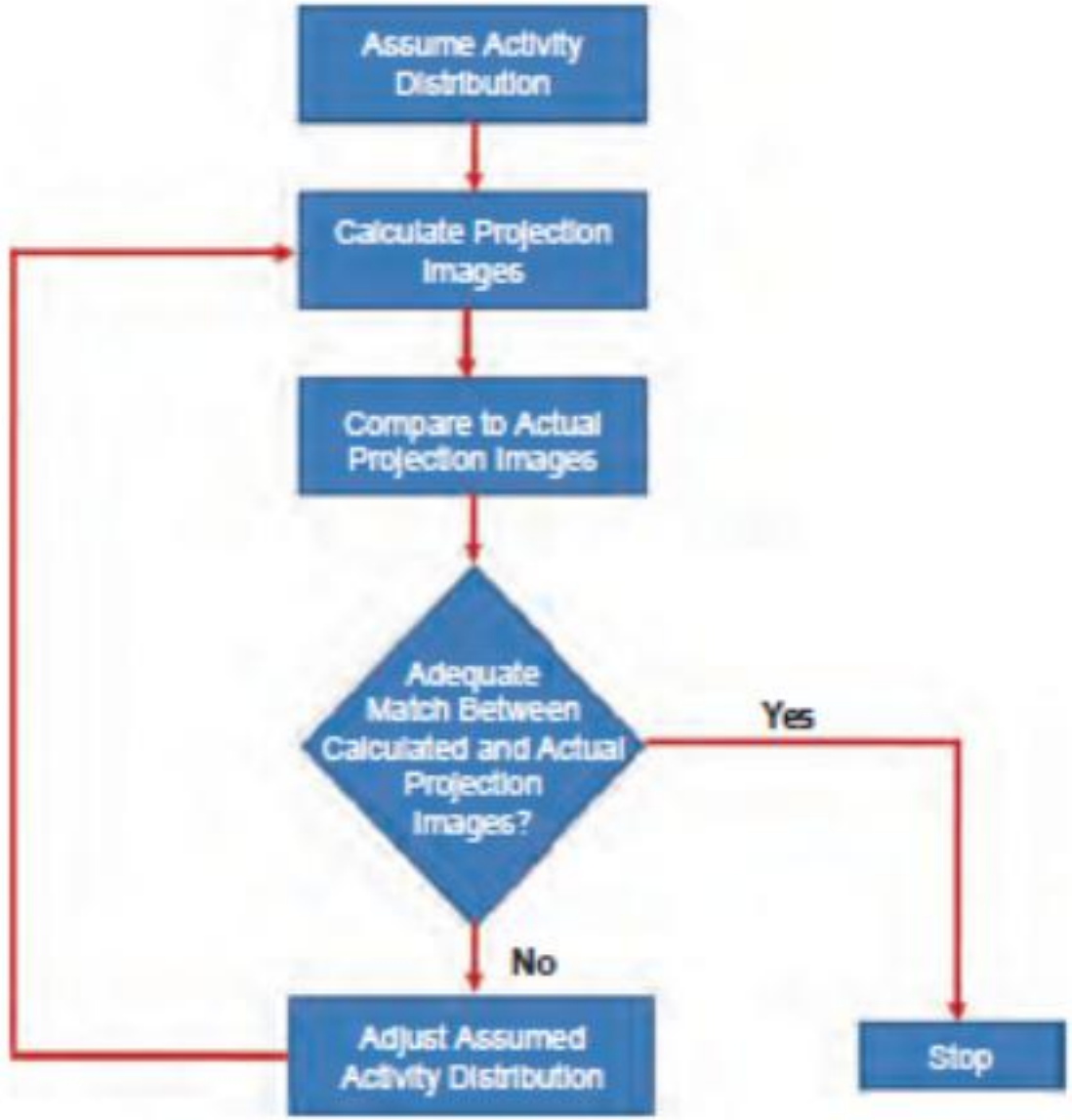

■ FIGURE 19-3 Circular (**A**) and body-contouring (**B**) orbits.

- In SPECT, iterative reconstruction methods are increasingly being used instead of filtered backprojection.

- Iterative methods are computationally less efficient than filtered backprojection.

  - Kalman Filter (Stochastic Filters),  Levenberg–Marquardt algorithm, methods to solve non-linear least squares problems, Gauss–Newton algorithm

■ **FIGURE 19-6** Flowchart for iterative reconstruction. In some implementations, iterative reconstruction is performed for a specified number of iterations, instead of being terminated when a sufficiently good approximation is achieved.



# Dual Modality Imaging

- SPECT and an x-ray CT scanner, with a single patient bed.

- In SPECT/CT systems, the x-ray CT attenuation image data can be used to correct the radionuclide emission data for attenuation by the patient.
- Advantages
  - 1
  - 2
  - …

- Most SPECT is performed using parallel-hole collimators.

- fan-beam collimator
  - hybrid of the converging and parallel-hole collimator
    - parallel-hole collimator in the y-direction
    - Converging collimator in x-direction

# Multihead SPECT Cameras

- higher resolution collimators can be used
- better images, in same amount of dose