Physics of Computed Tomography

Second Semester

Practical Part –Experiment -3
Week8: *Generations of CT scanners-2*

By

Prof.Dr.Raad Shaker Alnayli
MS.c.Reem Taumu Yousif

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✚ Sixth generation: Helical and spiral CT
✚ The advantages of a helical CT scan are:

1- The scan speed and patient throughput: e.g. a chest scan with 10 mm slice, can be done in single breath hold in 15–20 s (couch motion 10 mm/s, pitch1.5)

2- Avoids slice misregistration.

   3- Use of higher pitch reduces patient dose and exposure time.

✚ The disadvantages of a helical CT scan are:

1- It is relatively expensive.

   2- Precise identification of small distal stones is occasionally difficult.

✚ Uses of helical CT scan:

  1- Used to help diagnose disease.

  2- Plan treatment.

 3- Find out how well treatment is working

✚ Seventh Generation (MS/MD CT)

- The multislice CT (MSCT), or multi-detectorrow CT (MDCT),

- is a CT system equipped with multiple rows of CT detectors to create images of multiple sections.

- This CT system has different characteristics from conventional CT systems, which have only one row of CT detectors.

- 7th generation ct scanner used a cone shaped X ray beam. Unlike pencil beam and fan beam in earlier generation, cone beam does not pass through the narrow collimeter.

- And also linear array of detectors in previous generations are modified as flat panel detectors or multiple detector array.

- Thus 7th generation ct scanner can acquire more information in a very short span of time.
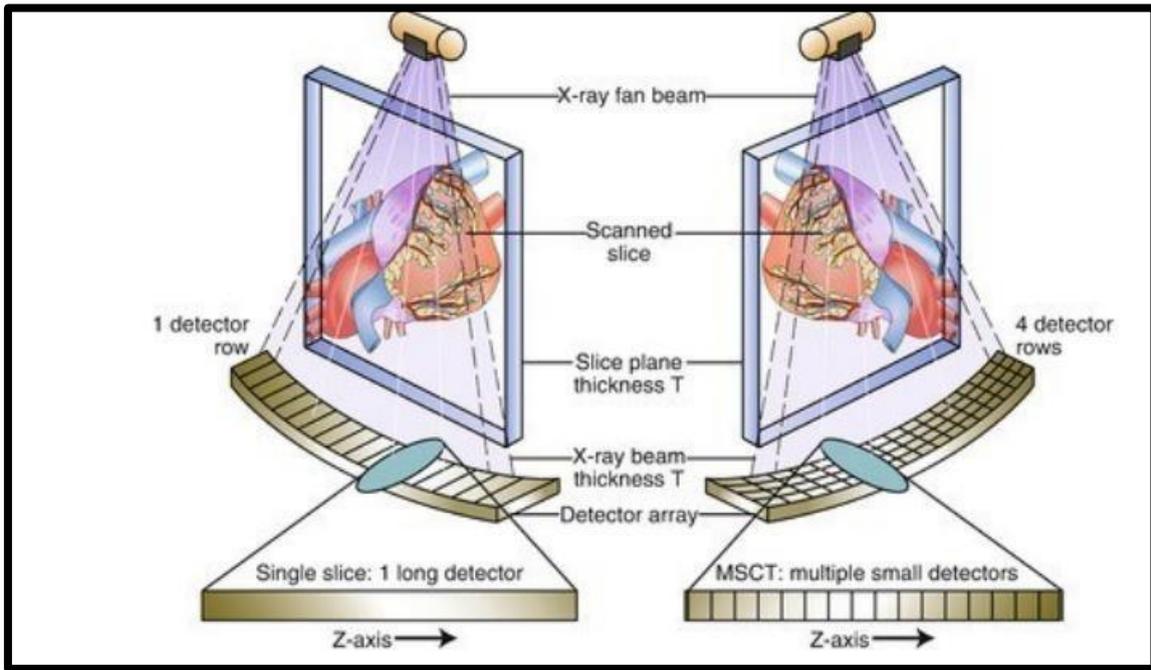
Figure 5: Multi slice computed tomography

The special features of MSCT are:

- Faster rotation subsecond times (0.5–0.8 s), that reduces the examination time.
- The image quality is similar to that of single slice scanners.
- It is different in dose, pitch, image artifacts, and method of image reconstruction.
- To scan longer anatomic area, more than 4 slices are required and hence gantry speed has to be increased.

Multidetector array

Multidetector array is a combination of several linear arrays (multiple solid state detector array). In this, the X-ray tube is directed at multiple rows of detectors along the longitudinal (Z) axis. Each row has hundreds of separate detector elements (Figure2). It has separate data acquisition channels for each detector element and can generate multiple channels (4, 8, 16, and 64) of spatial data.

Difference between single slice and multislice scanner:

1. MSCT perform 0.5 s rotation with simultaneous acquisition of 4 slices.
2. It gives 8 times higher performance than single section CT, for same scanning time.

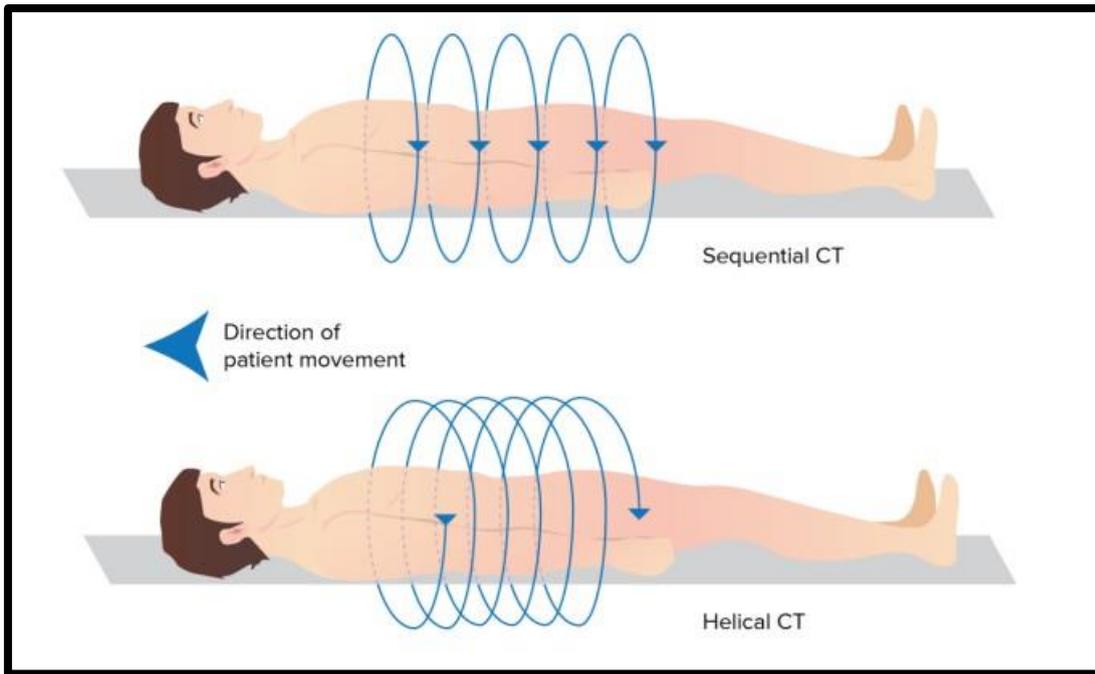3. Recent advances has brought scanners with 4, 8, 16, and 64 slices in practice.

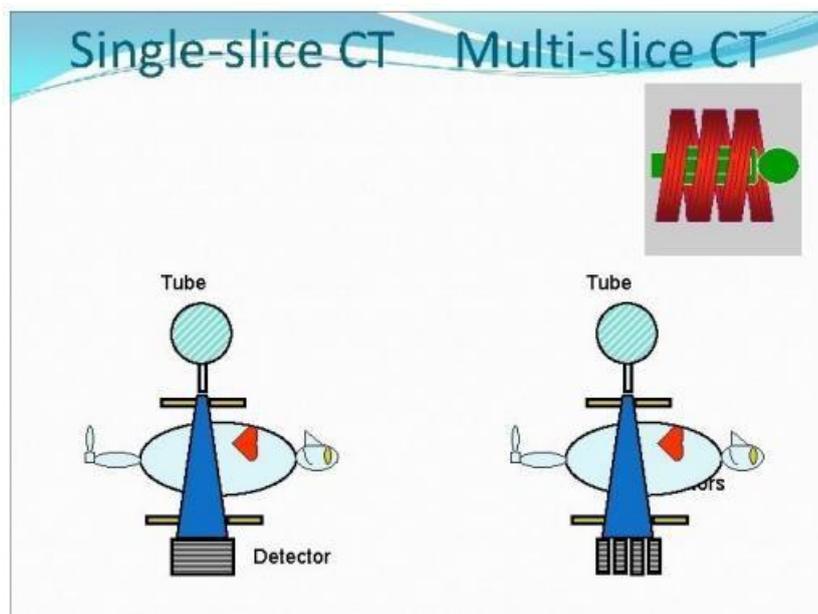Figure2: Difference between the Sequential CT and helical CT

Figure3: single and multislice computed tomography.

1. In a single slice scanner, the detectors are wide (15 mm) and collimator determines (adjustment) slice thickness of 1–13 mm.

2. In a MSCT, the individual detector elements along the z-axis are summed, to get several slice thickness. Thus, the slice width is determined by the detector not by the collimator (figure4).
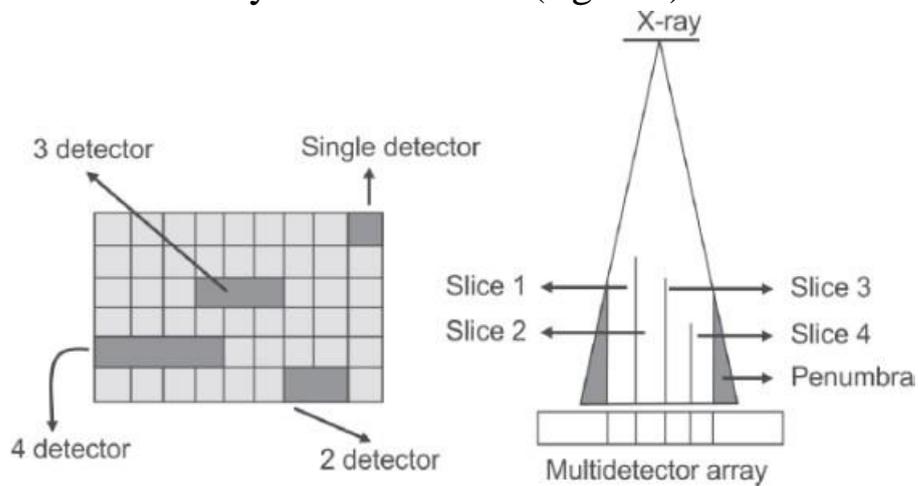
Figure4: Multidetector array and slice selection.