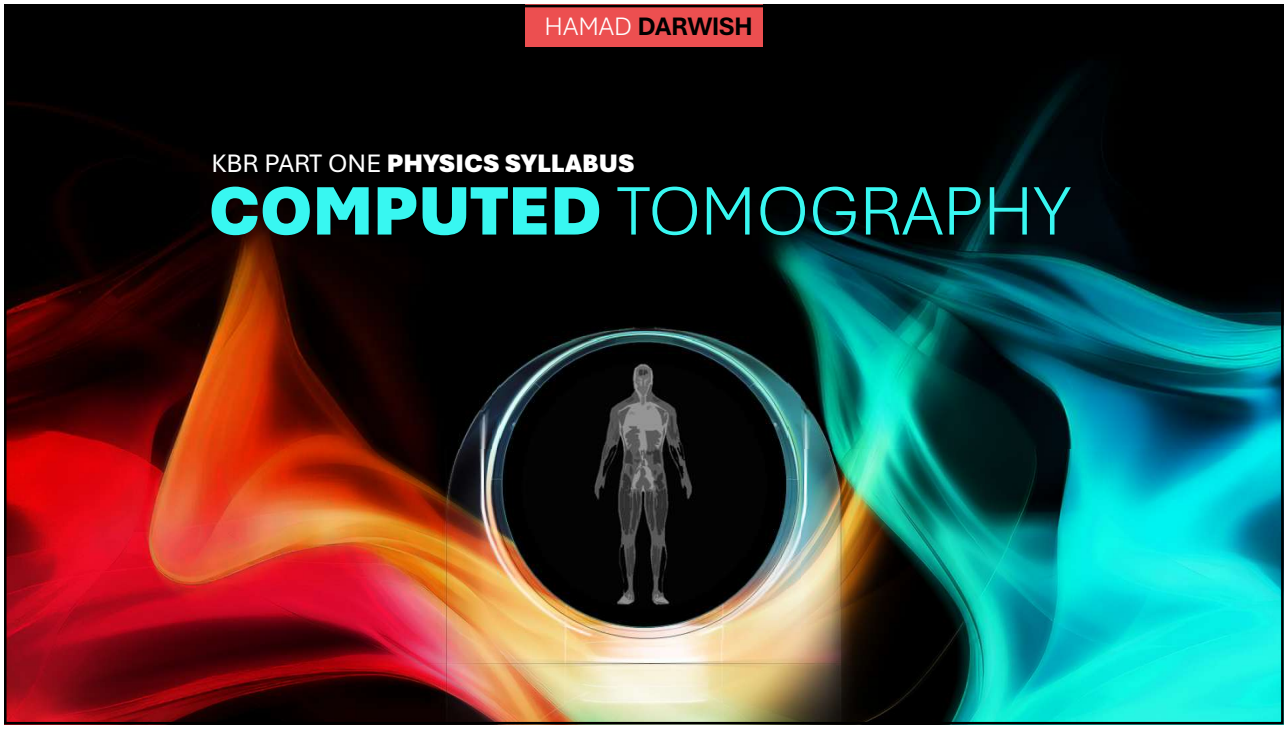
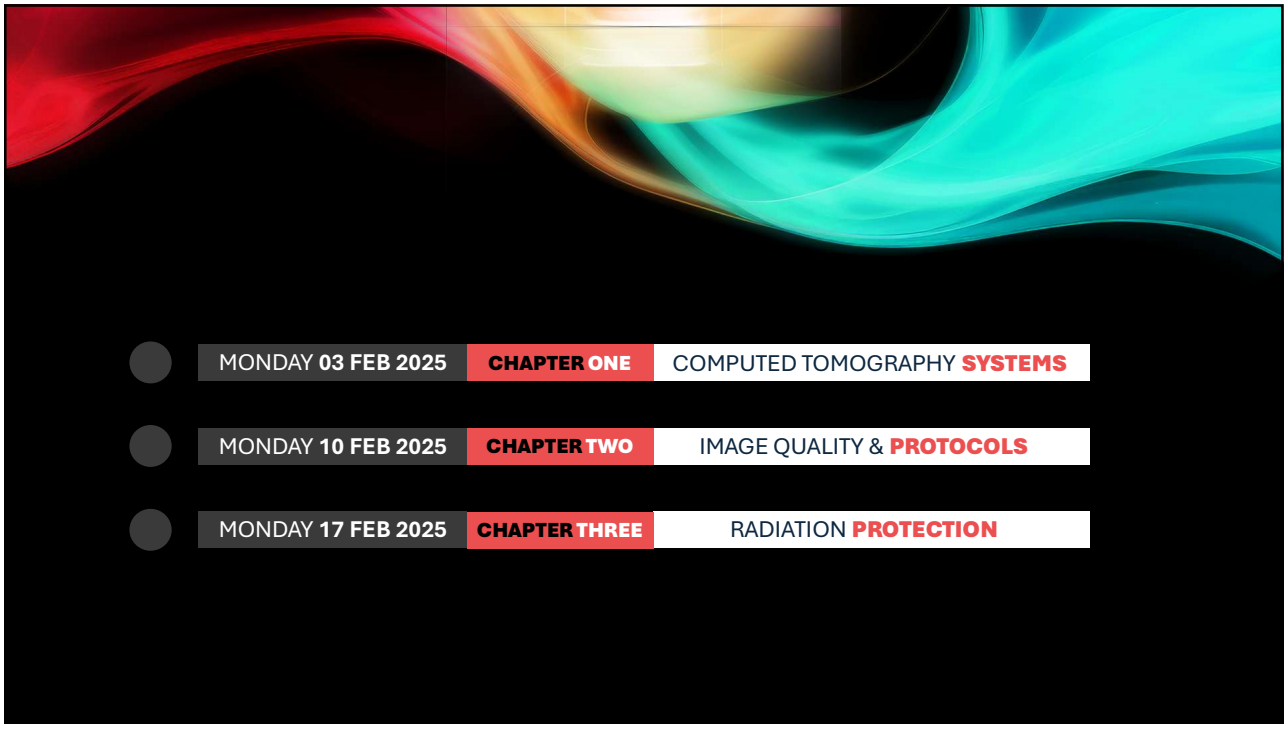
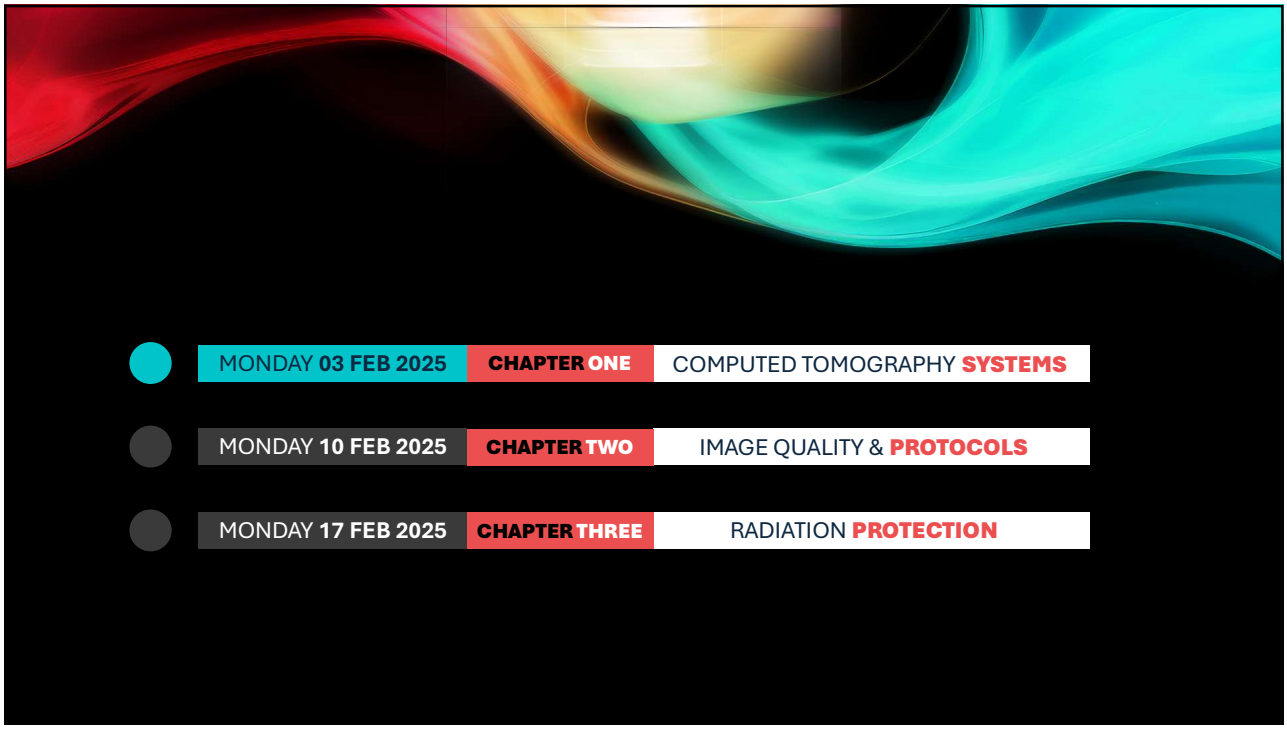

HAMAD DARWISH
KBR PART ONE PHYSICS SYLLABUS
COMPUTED TOMOGRAPHY

2


MONDAY 03 FEB 2025
CHAPTER ONE
COMPUTED TOMOGRAPHY SYSTEMS
MONDAY 10 FEB 2025
CHAPTER TWO
IMAGE QUALITY & PROTOCOLS
MONDAY 17 FEB 2025
CHAPTER THREE
RADIATION PROTECTION

3


MONDAY 03 FEB 2025
CHAPTER ONE
COMPUTED TOMOGRAPHY SYSTEMS
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MONDAY 17 FEB 2025
CHAPTER THREE
RADIATION PROTECTION

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KEY PRINCIPLES
TYPES & COMPONENTS
ACQUISITION MODES
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CHAPTER
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KEY PRINCIPLES
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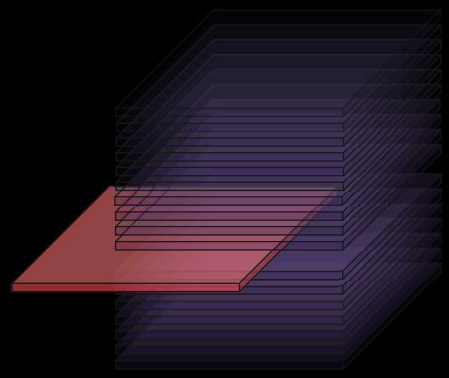
ACQUISITION MODES
IMAGE FORMATION

7

COMPUTED TOMOGRAPHY

Computed Tomography (CT) is a imaging technique that **uses x-rays** to create detailed **cross-sectional images** of the body. It provides significantly more information than traditional 2D radiography.



CH.1

8

COMPUTED TOMOGRAPHY

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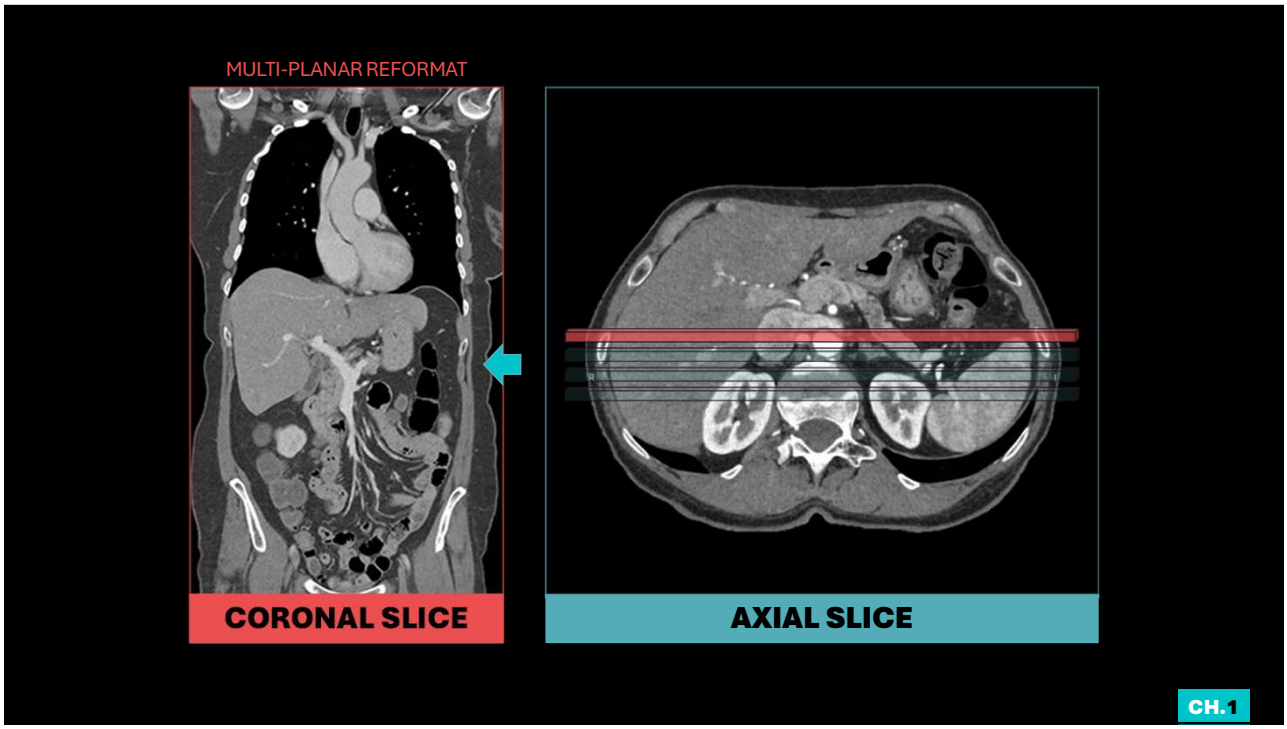
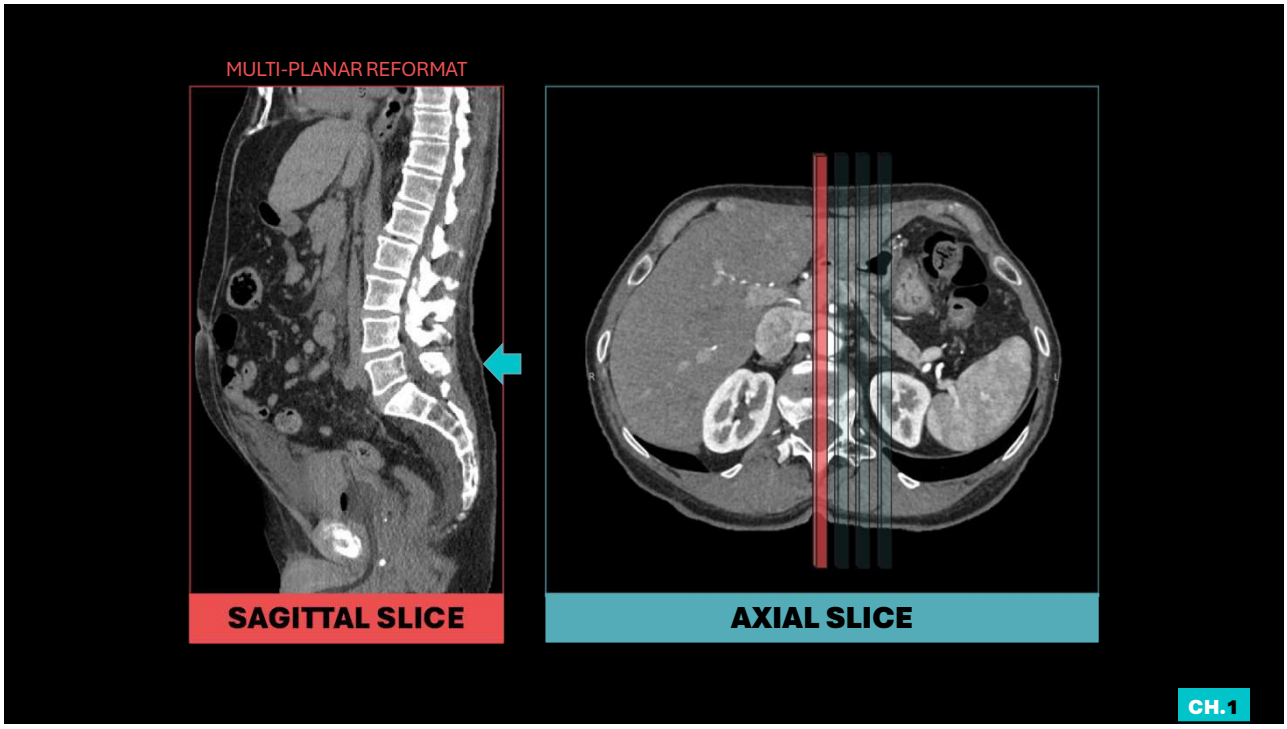
CH.1

9


MULTI-PLANAR REFORMAT
CORONAL SLICE
AXIAL SLICE
CH.1

10


MULTI-PLANAR REFORMAT
SAGITTAL SLICE
AXIAL SLICE
CH.1

11

THE IMPACT OF CT

In summary, CT has revolutionized medical imaging by providing a powerful tool for visualizing internal anatomy with exceptional detail and clarity. Its versatility, speed, and ability to differentiate between subtle tissue differences have made it indispensable in modern healthcare, leading to improved diagnosis, treatment, and patient care across numerous medical specialties.

- Improved accuracy of diagnosis
- Minimally invasive
- Enhanced treatment planning
- Better patient outcomes

CH.1

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CHAPTER
ONE
OVERVIEW
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IMAGE FORMATION

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CHAPTER
ONE
OVERVIEW
KEY PRINCIPLES
TYPES & COMPONENTS
ACQUISITION MODES
IMAGE FORMATION

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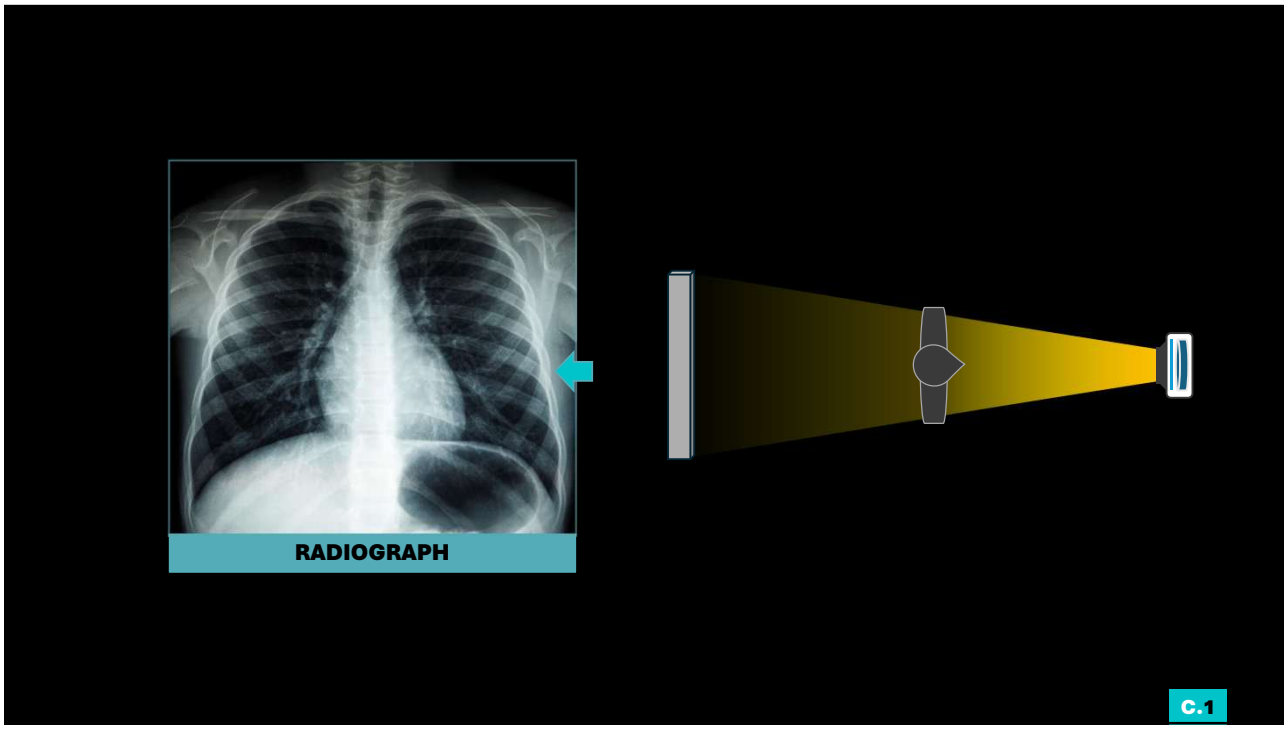

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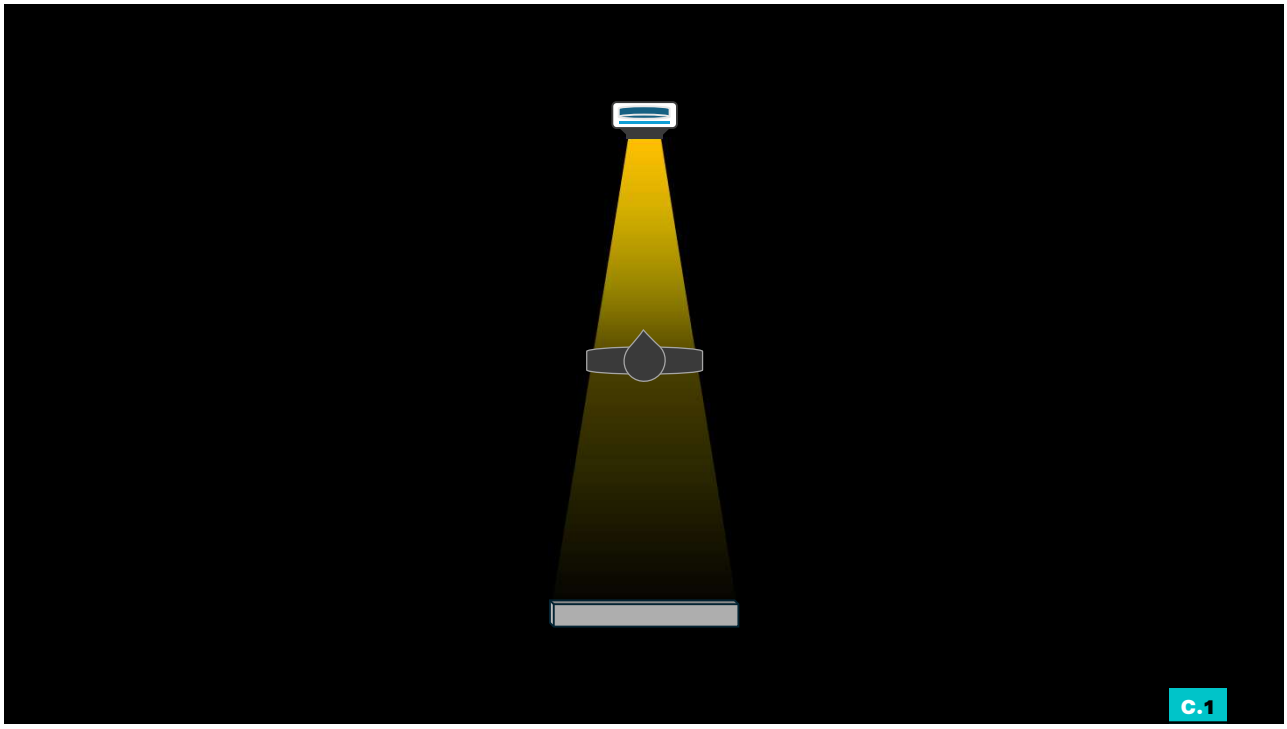

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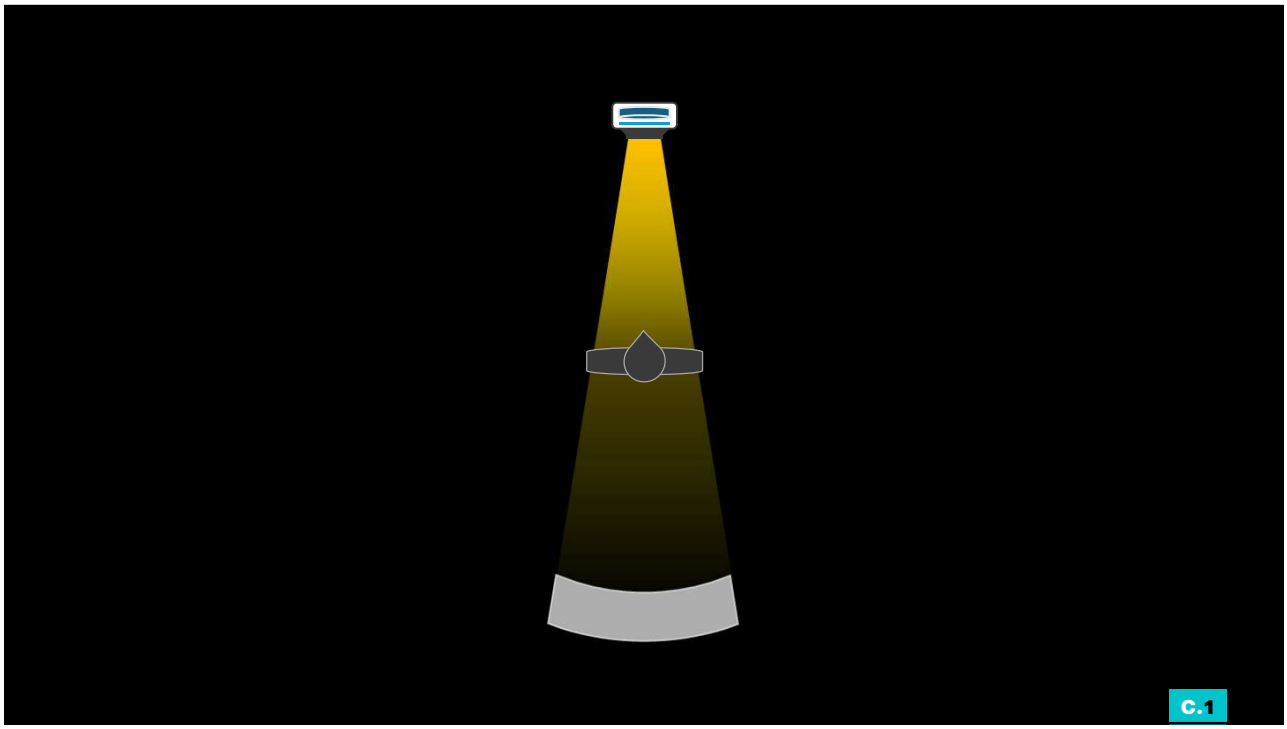

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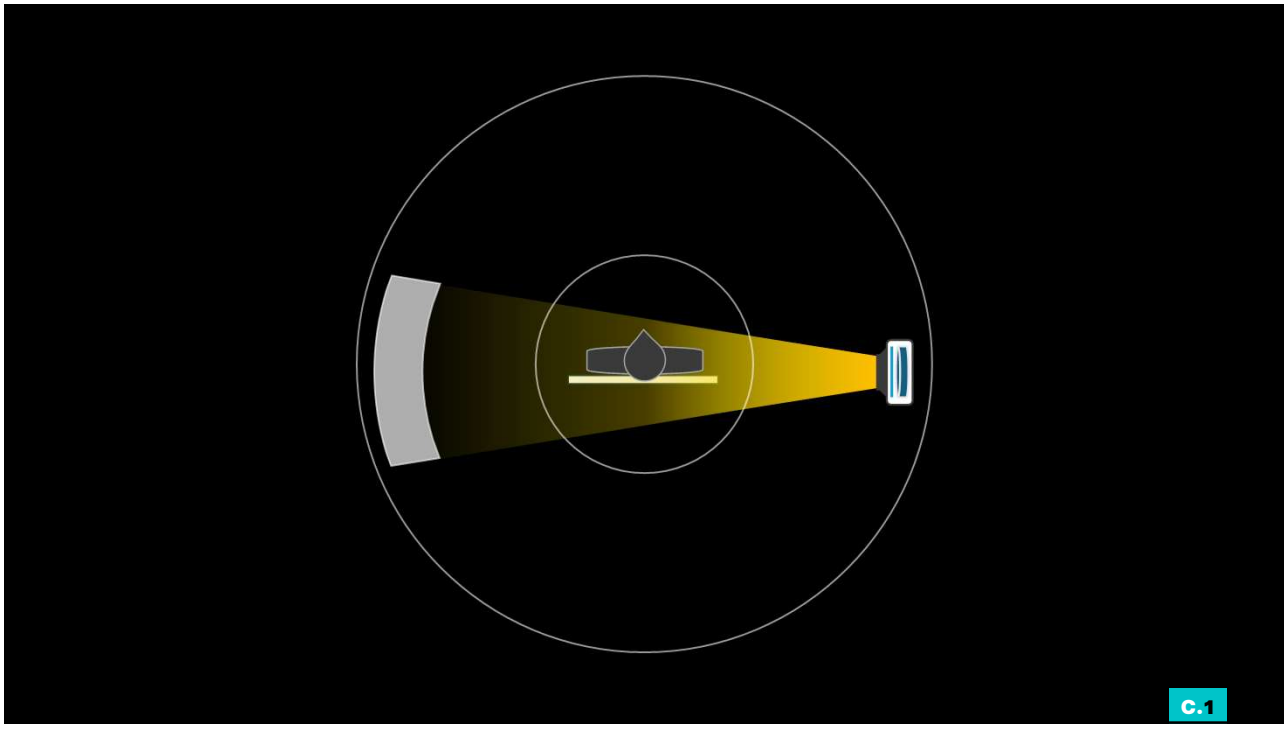

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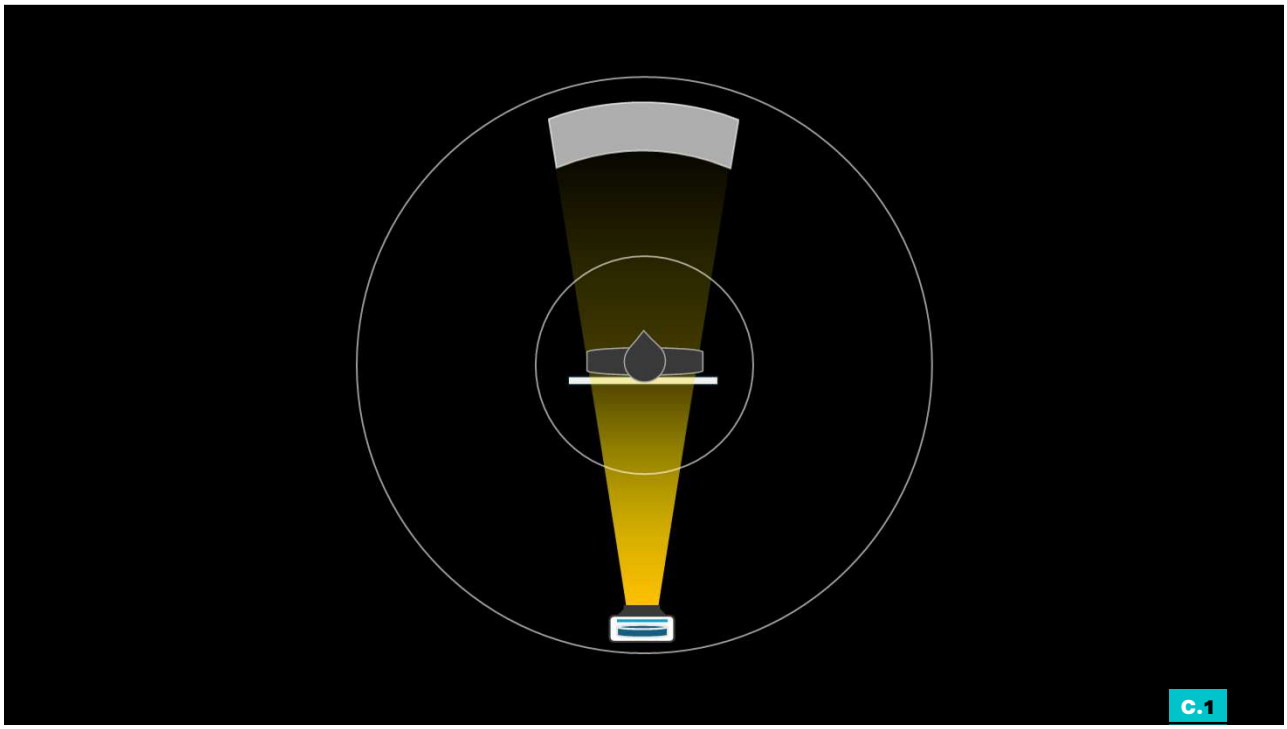

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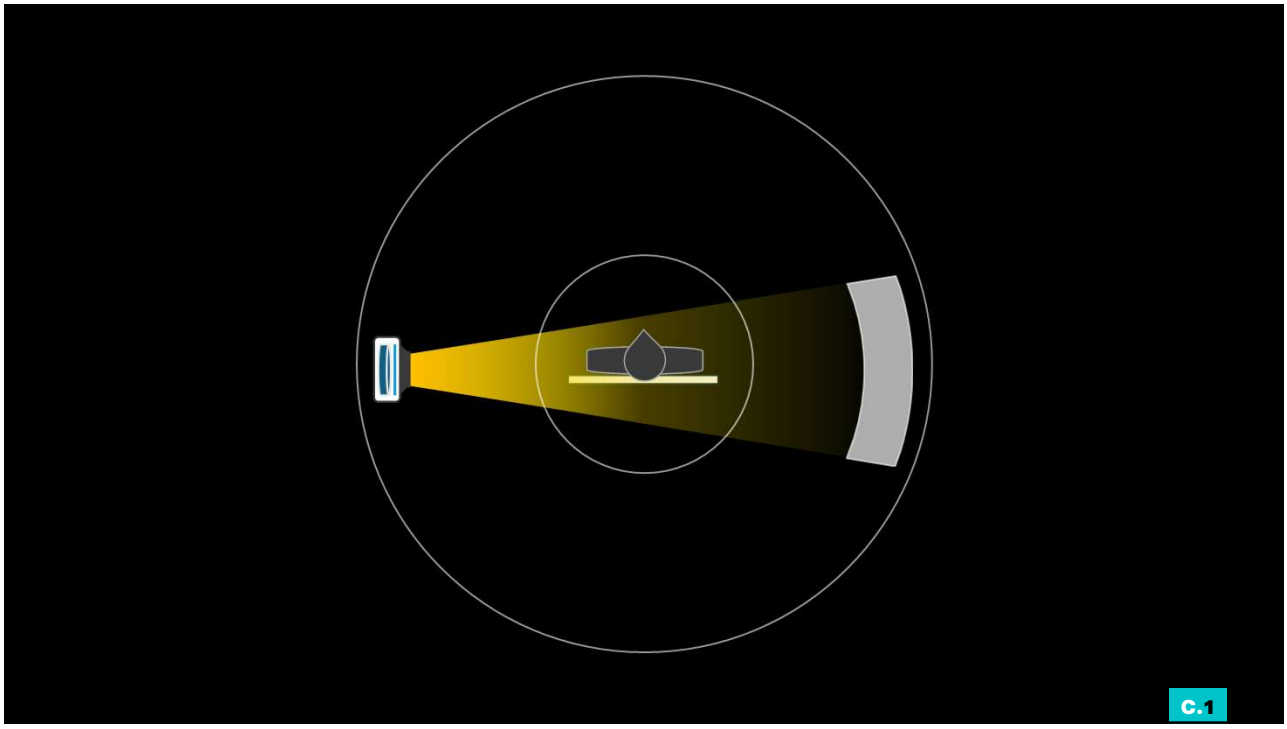

23

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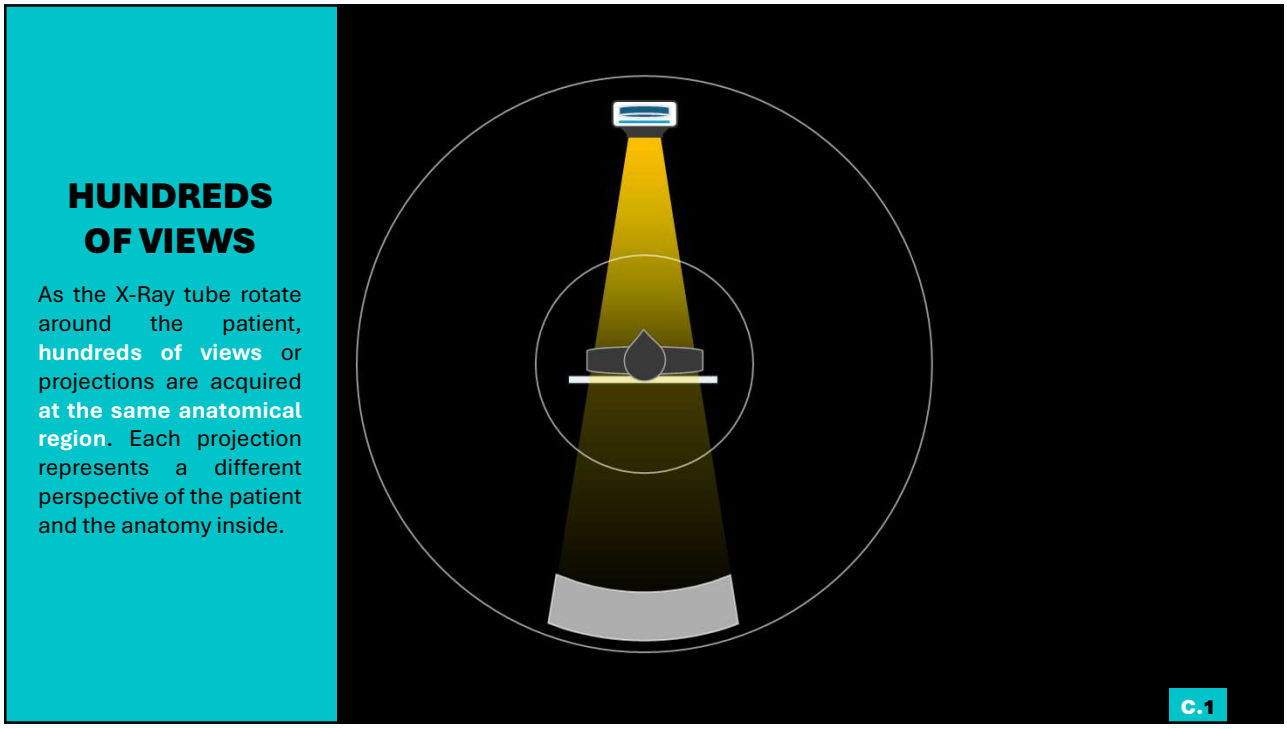
HUNDREDS OF VIEWS

As the X-Ray tube rotate around the patient, **hundreds of views** or projections are acquired **at the same anatomical region**. Each projection represents a different perspective of the patient and the anatomy inside.



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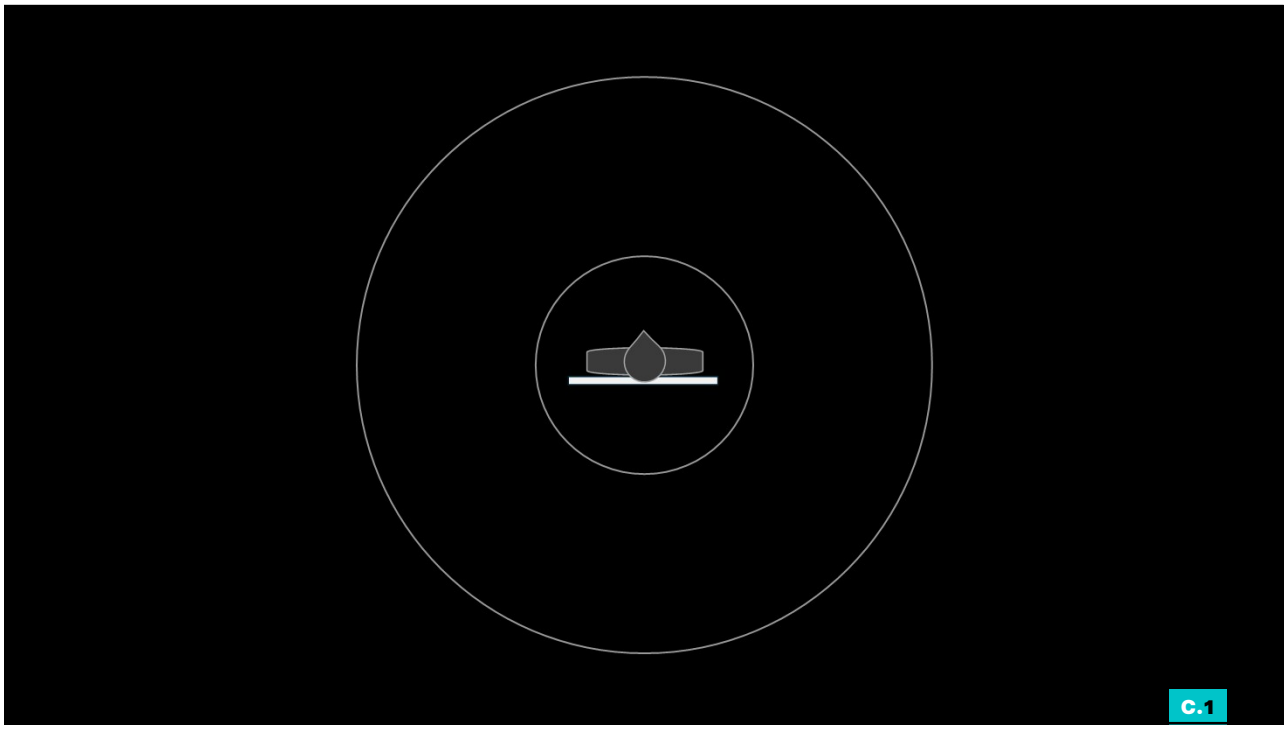

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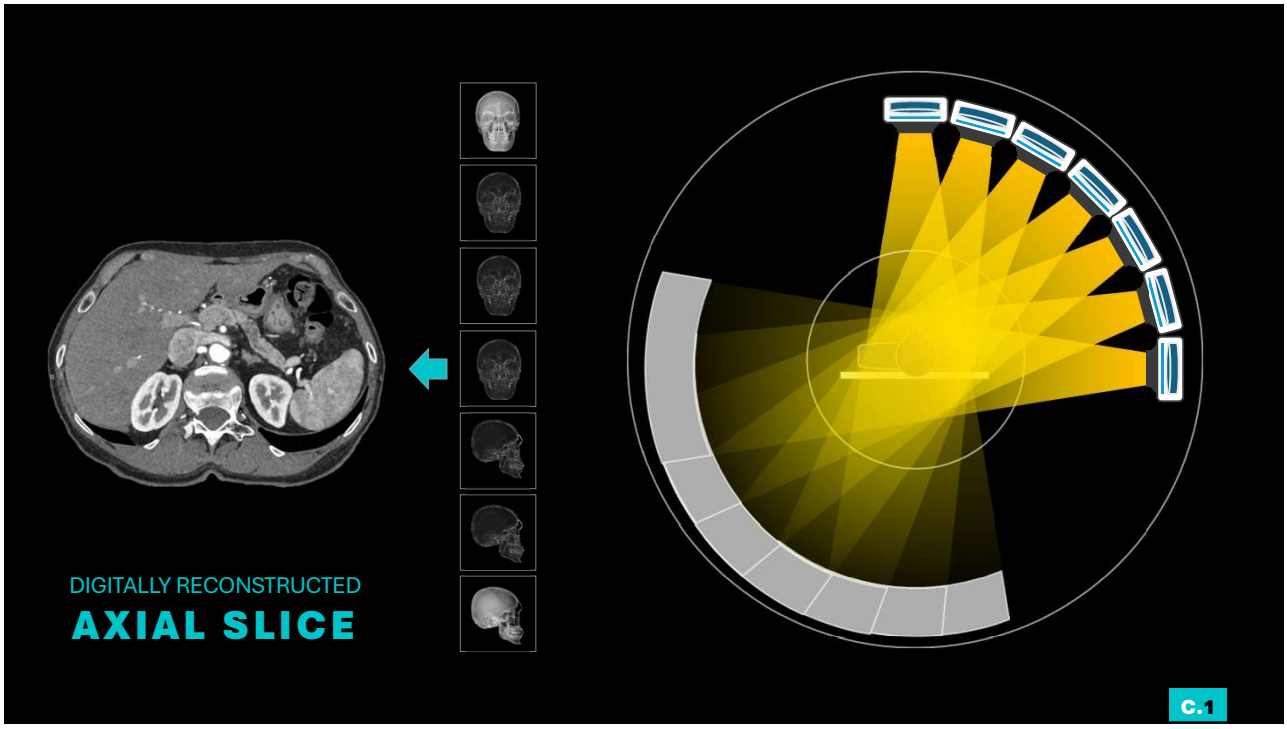

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→ KEY PRINCIPLES
→ TYPES & COMPONENTS
→ ACQUISITION MODES
→ IMAGE FORMATION

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CHAPTER
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OVERVIEW
KEY PRINCIPLES
TYPES & COMPONENTS
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IMAGE FORMATION

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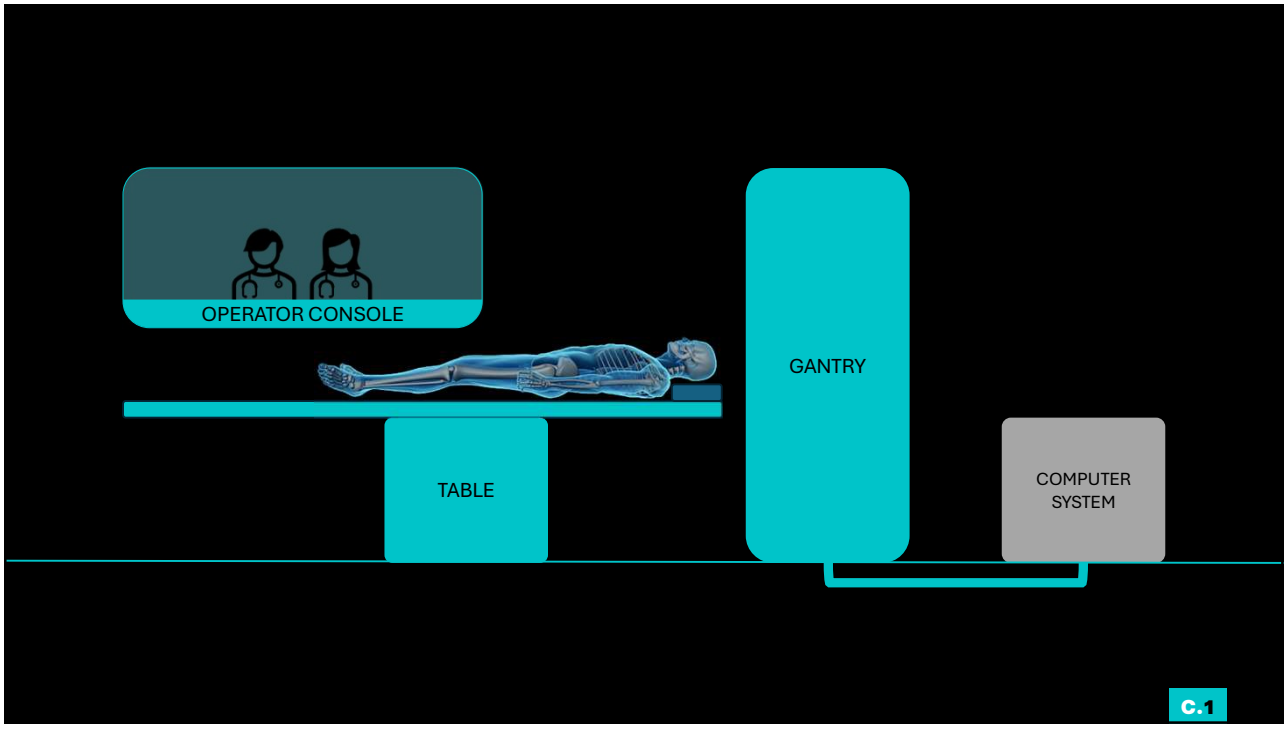
OPERATOR CONSOLE
TABLE
GANTRY
COMPUTER
SYSTEM
C.1

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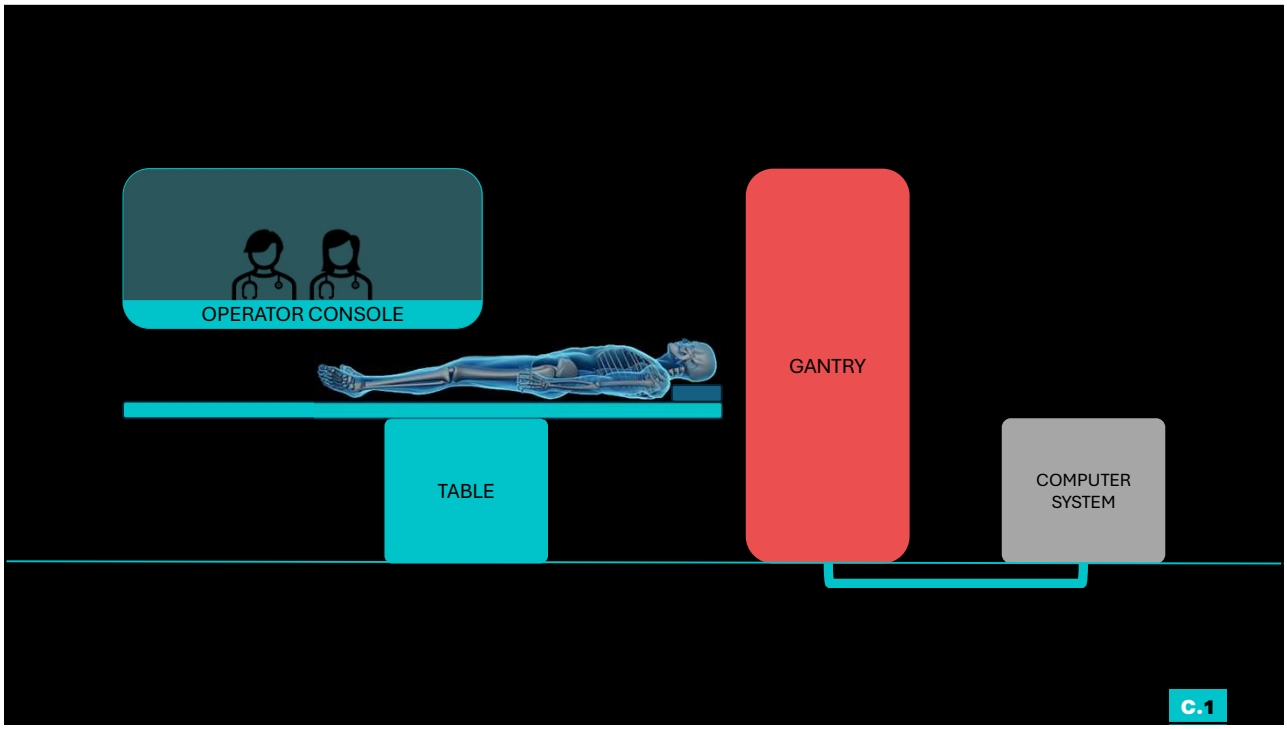

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GANTRY

The Heart of the System; a donut-shaped structure that houses the **key components responsible for image acquisition**.

C.1

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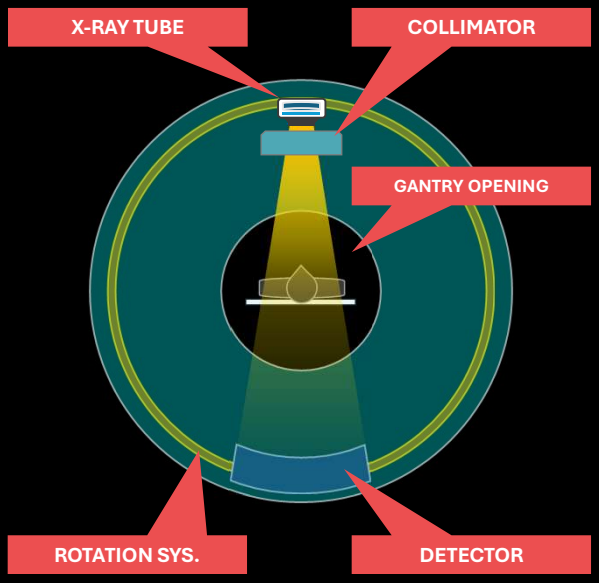
KEY COMPONENETS:

1. Gantry opening
2. X-Ray tube
3. Collimator
4. Detector (detector array)
5. Rotation system mechanism

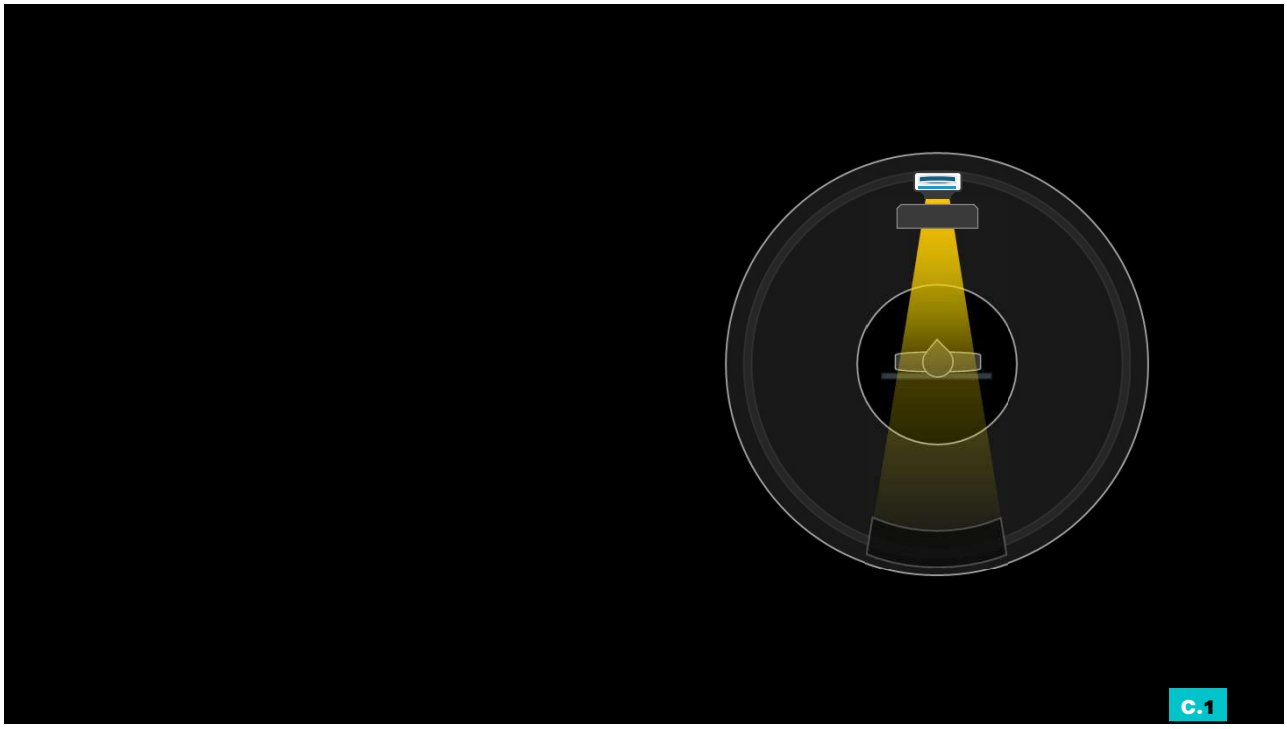
OTHER FEATURES:

1. Patient positioning lasers
2. Patient data display
3. Tilt capability



C.1

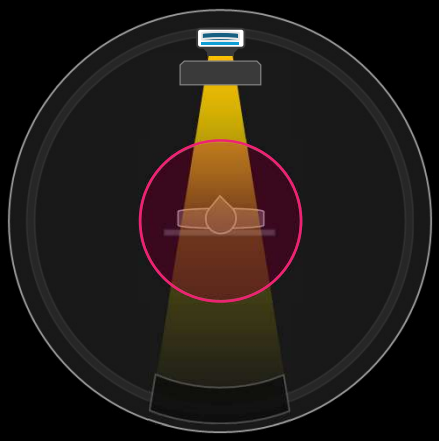
34



35

GANTRY OPENING

the size of the gantry opening is crucial. It determines the **maximum allowed patient size** and the maximum possible **scan field of view** (SFOV)



C.1

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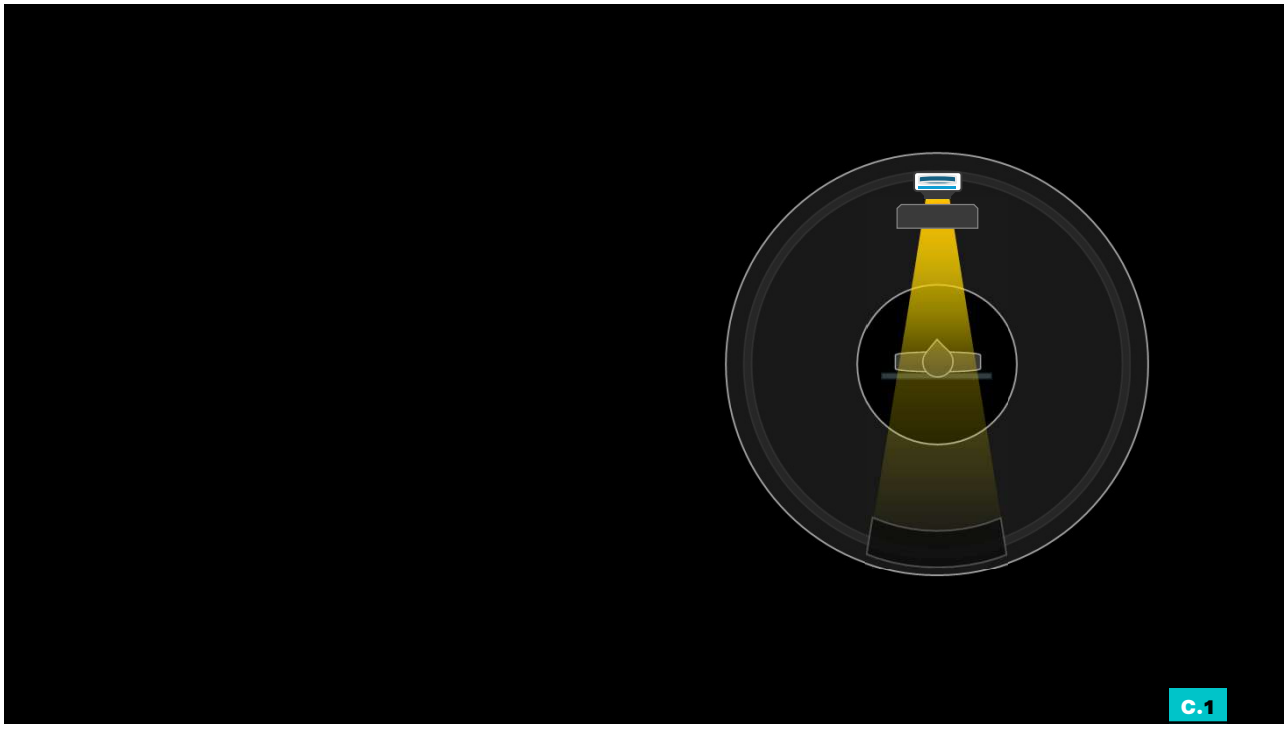

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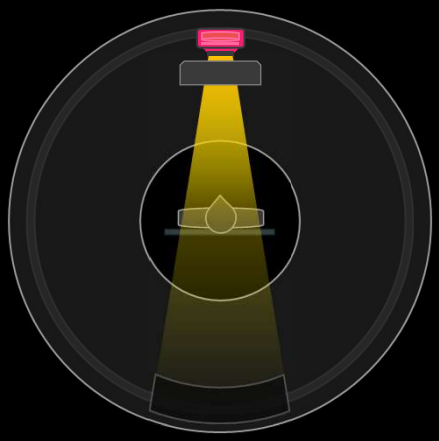
X-RAY TUBE

the CT X-Ray tube is similar to the one used in general radiography in principle. However, it differs in performance greatly. CT X-Ray tubes have **substantially higher heat capacity** to allow them to tolerate the higher mA values and longer exposure times necessary for CT procedures.



C.1

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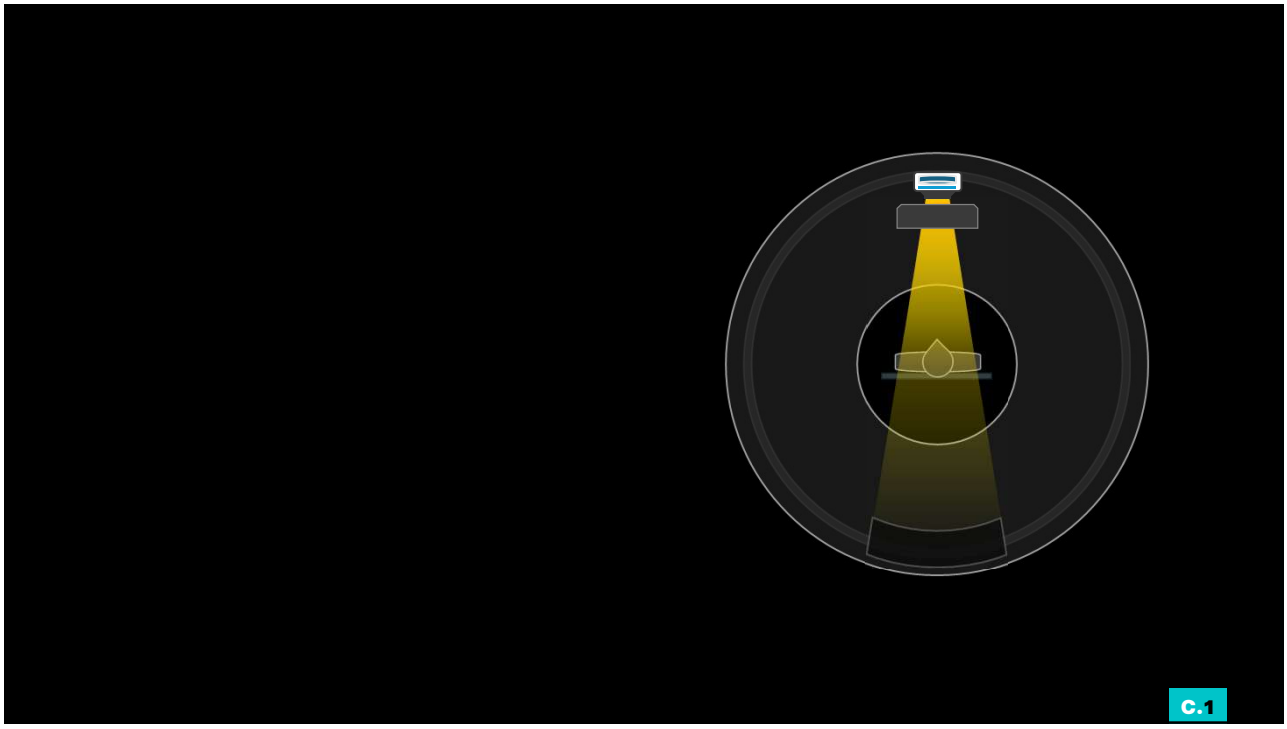

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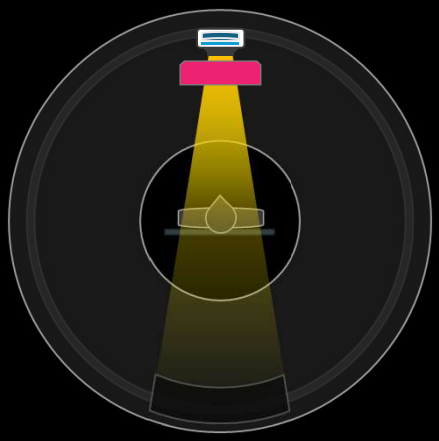
COLLIMATORS

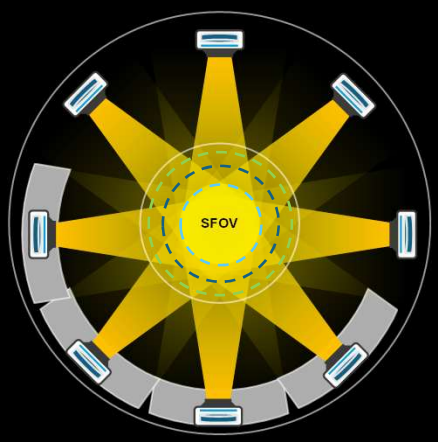
Beam limiting device responsible for adjusting the width of the beam. Adjusting the width in:

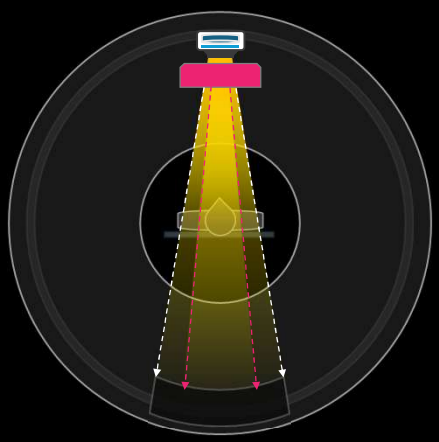
- **X-Y-Axis:** affects the scan field of view (SFOV)
- **Z-axis:** affects the patient coverage per rotation



40

COLLIMATION: X-Y-AXIS



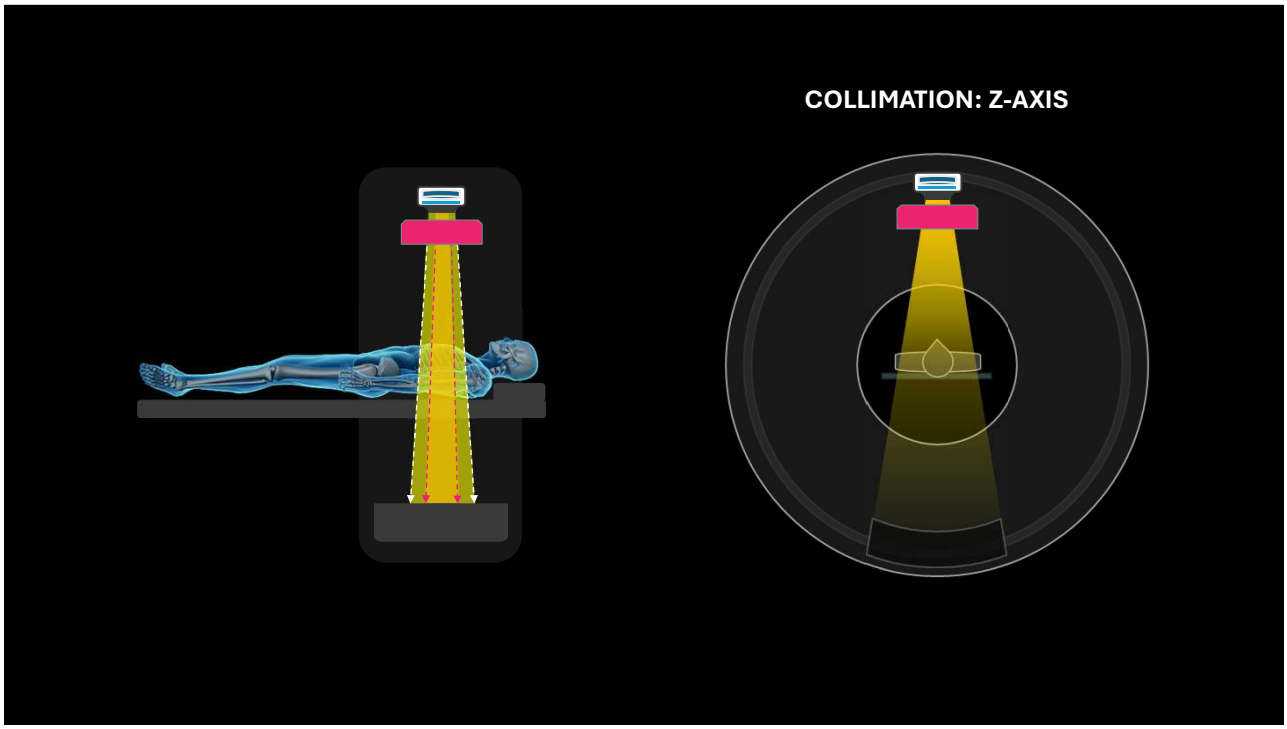


SFOV SIZES

SMALL | MEDIUM | LARGE

The largest possible SFOV is limited by the gantry opening size and length of the detector

41



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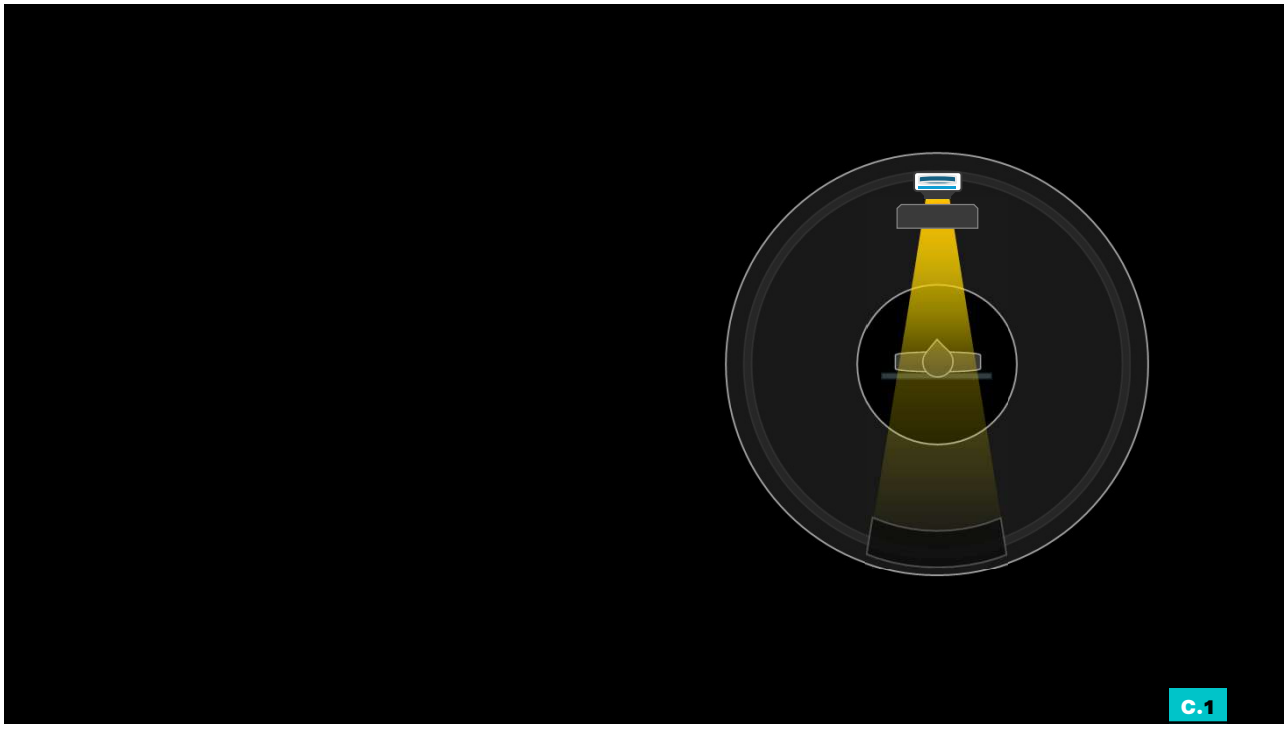
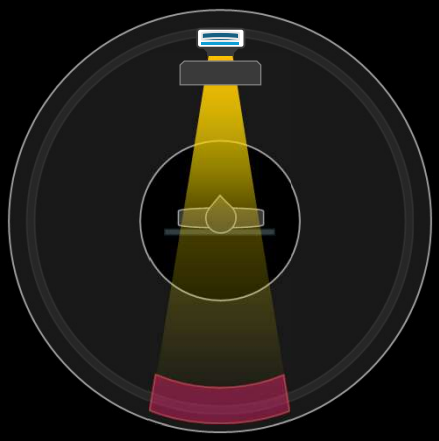


43

DETECTOR

One of most important parts of the CT scanner (if not the most important!). The detector is responsible for many of the performance characteristics of the scanner.



C.1

44

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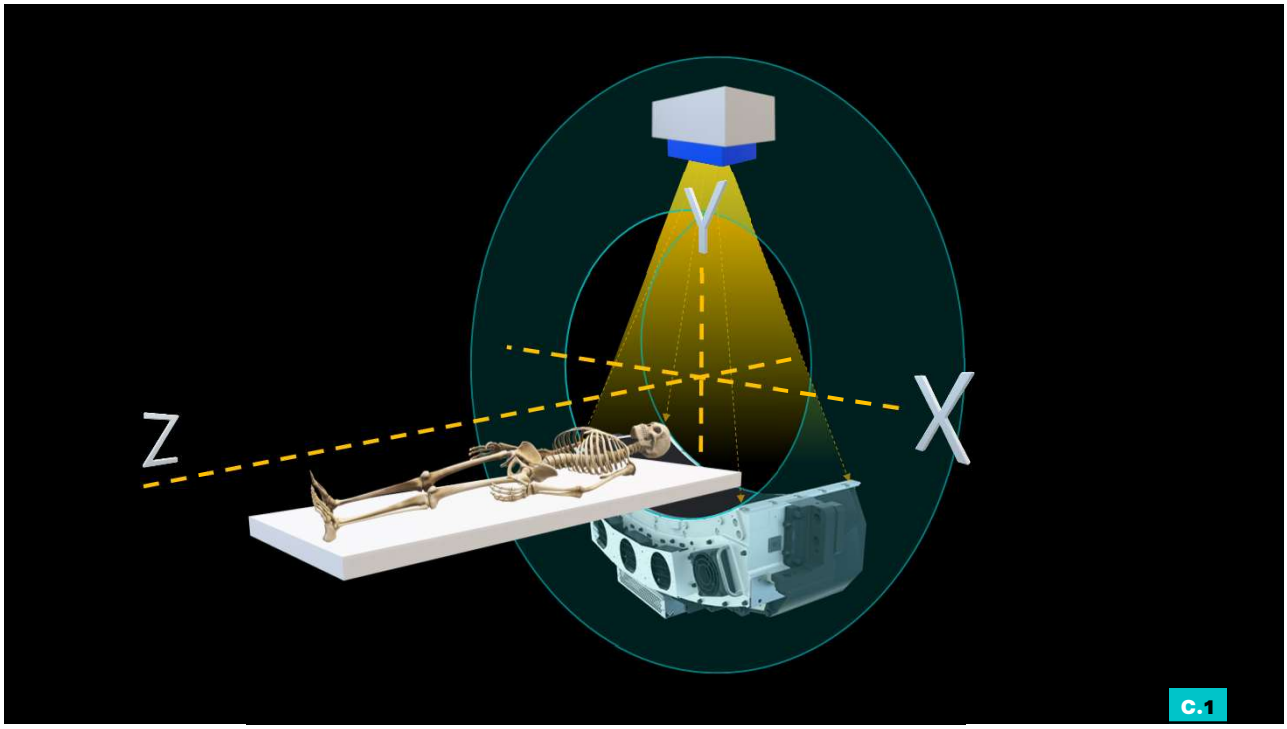
C.1

45

46



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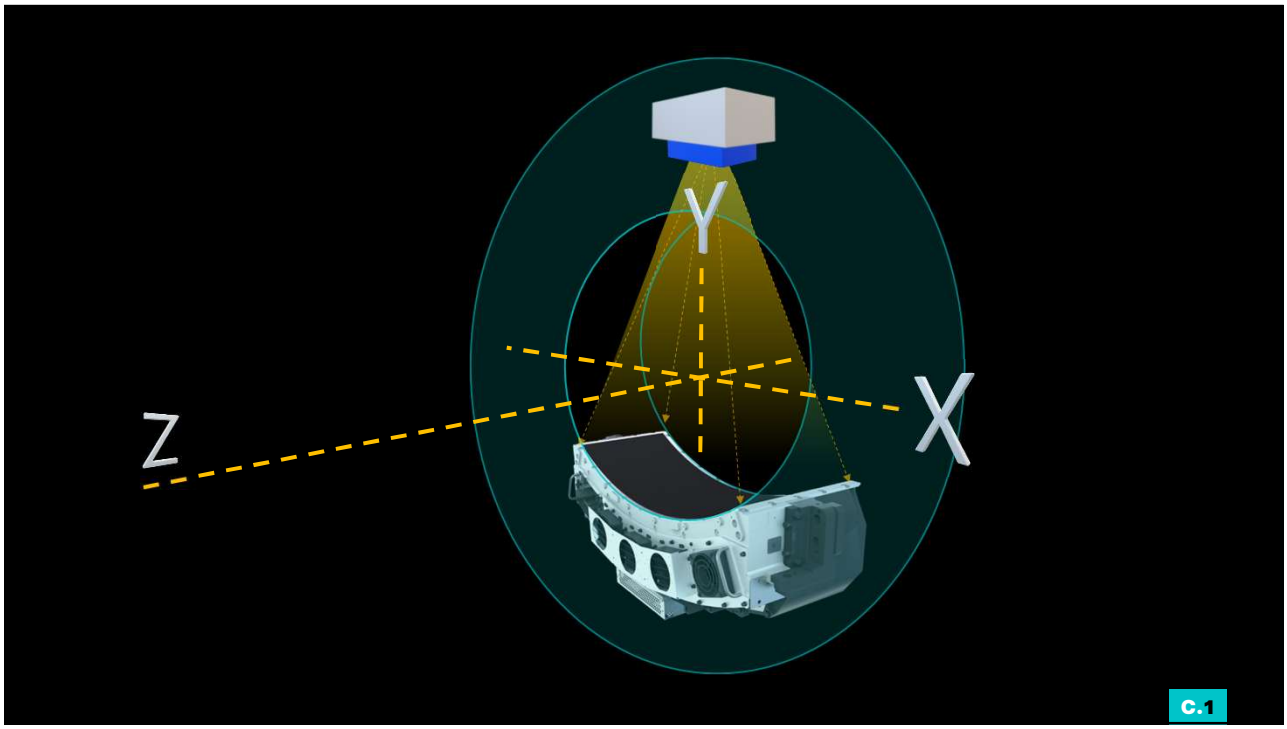
Y
Z
X
C.1

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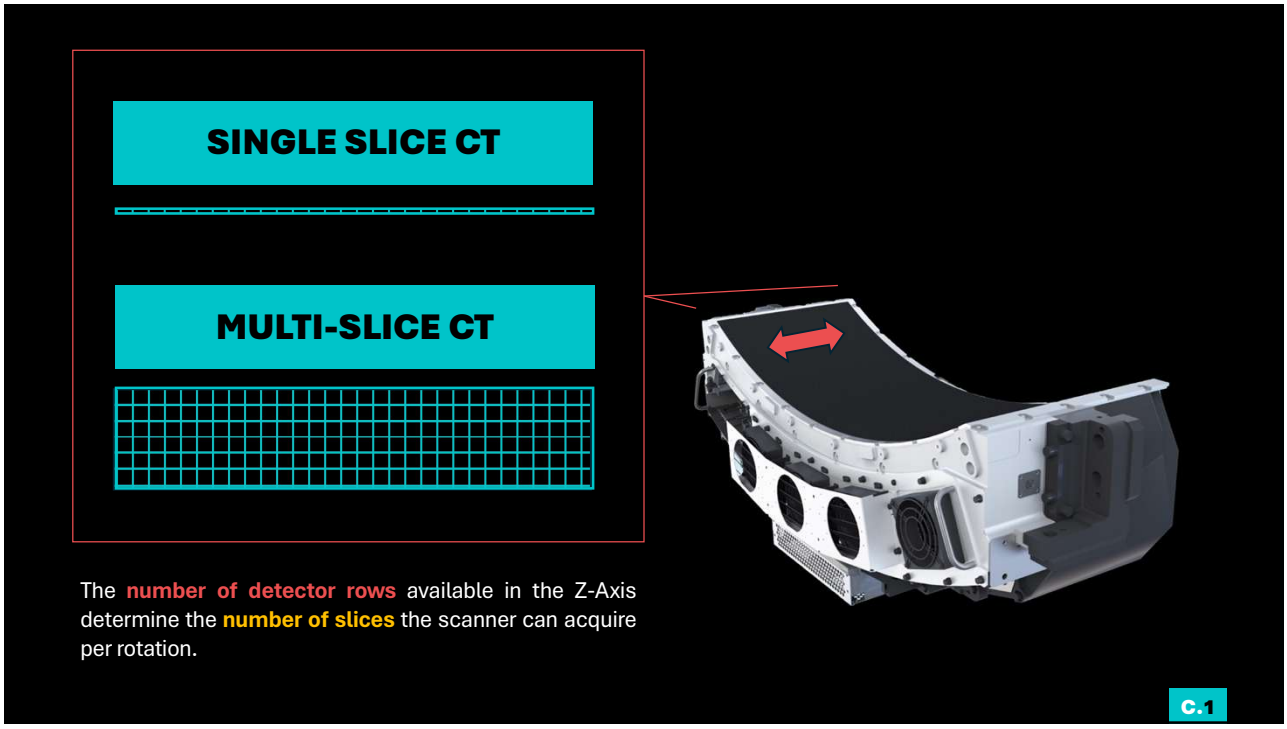
SINGLE SLICE CT
MULTI-SLICE CT
The number of detector rows available in the Z-Axis determine the number of slices the scanner can acquire per rotation.
C.1

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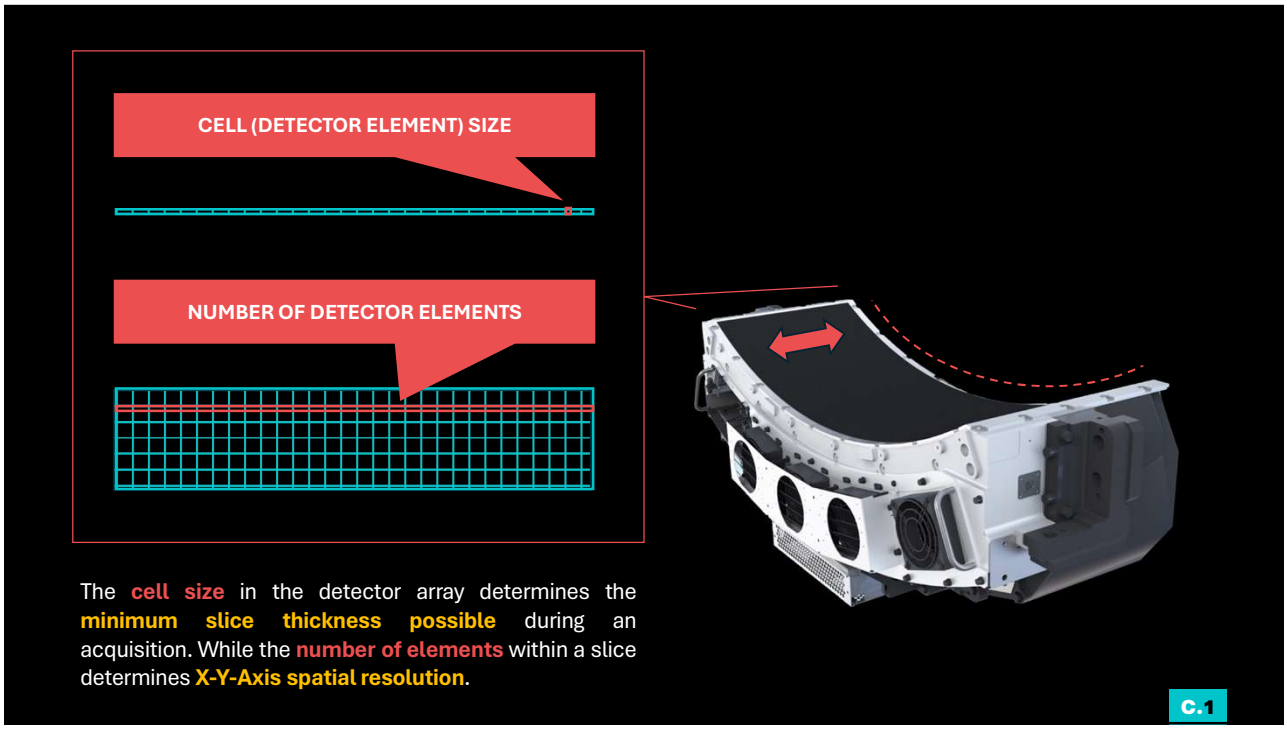
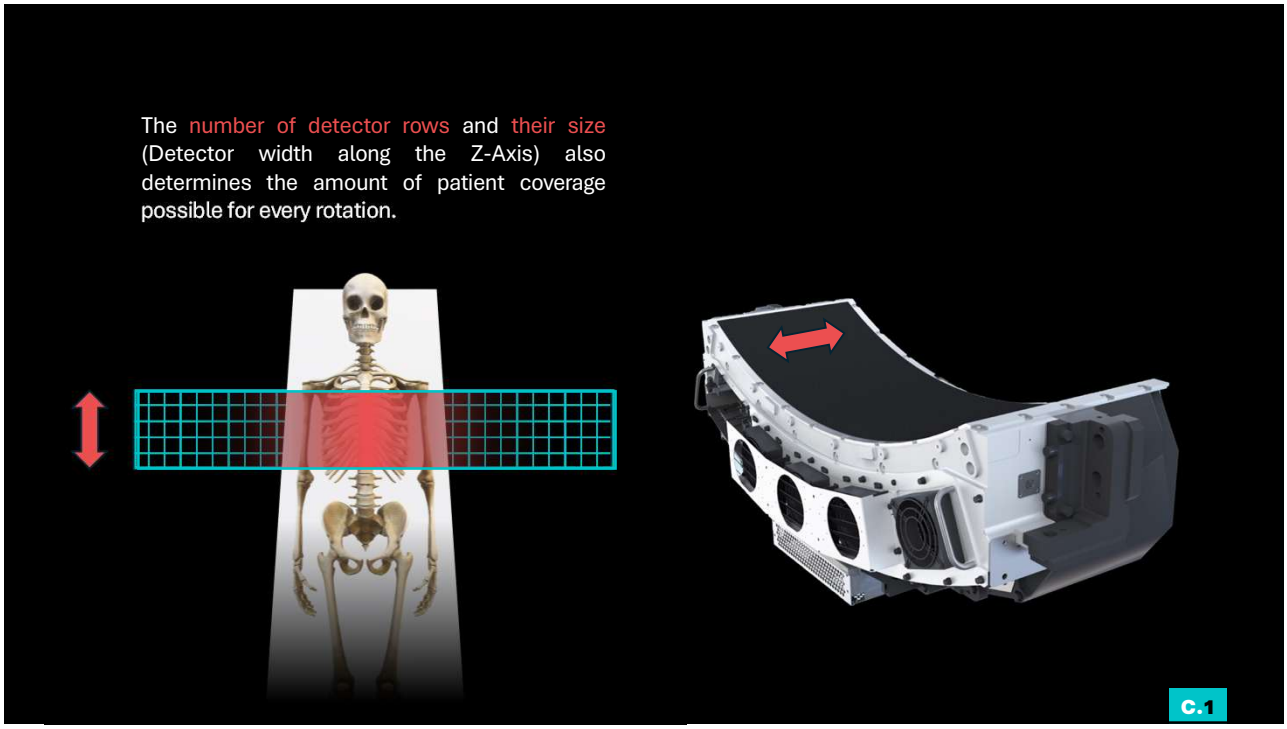
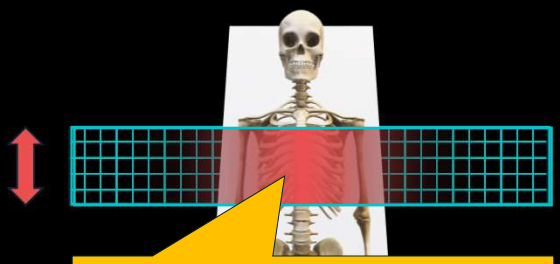

CELL (DETECTOR ELEMENT) SIZE
NUMBER OF DETECTOR ELEMENTS
The cell size in the detector array determines the minimum slice thickness possible during an acquisition. While the number of elements within a slice determines X-Y-Axis spatial resolution.
C.1

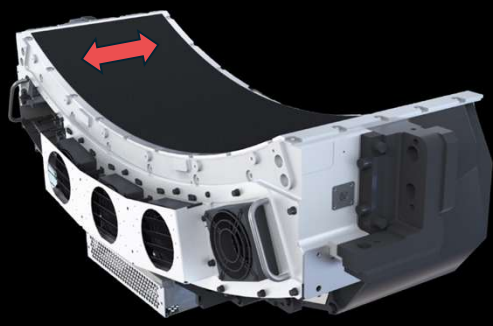
50


The number of detector rows and their size (Detector width along the Z-Axis) also determines the amount of patient coverage possible for every rotation.
C.1

51

The number of detector rows and their size (Detector width along the Z-Axis) also determines the amount of patient coverage possible for every rotation.





64 Row (slice) detector with **0.625mm cell size** has **Z-Axis coverage** of (64x0.625mm) = 40mm

320 Row (slice) detector with **0.5mm cell size** has **Z-Axis coverage** of (320x0.5mm) = 160mm

C.1

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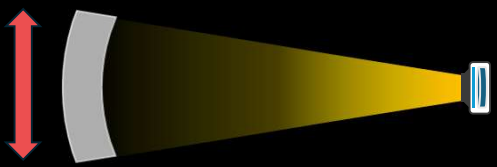
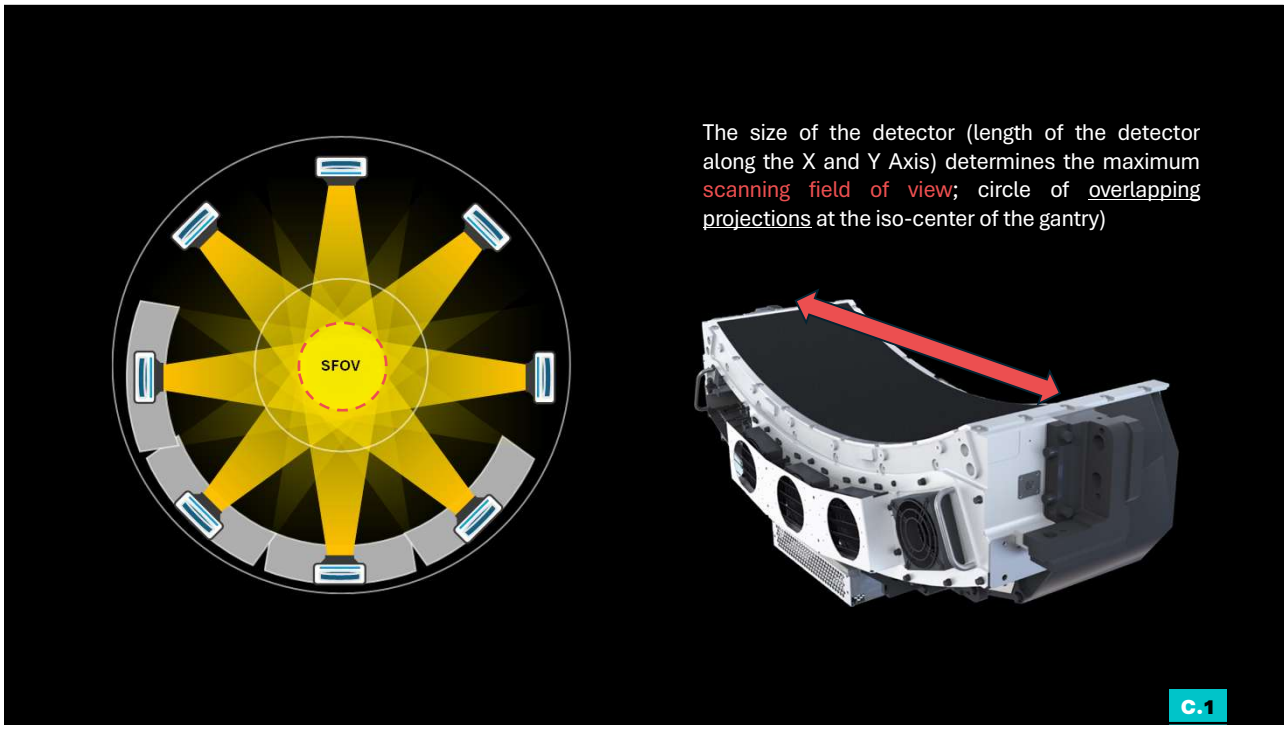
The size of the detector (length of the detector along the X and Y Axis) determines the maximum scanning field of view; circle of overlapping projections at the iso-center of the gantry)

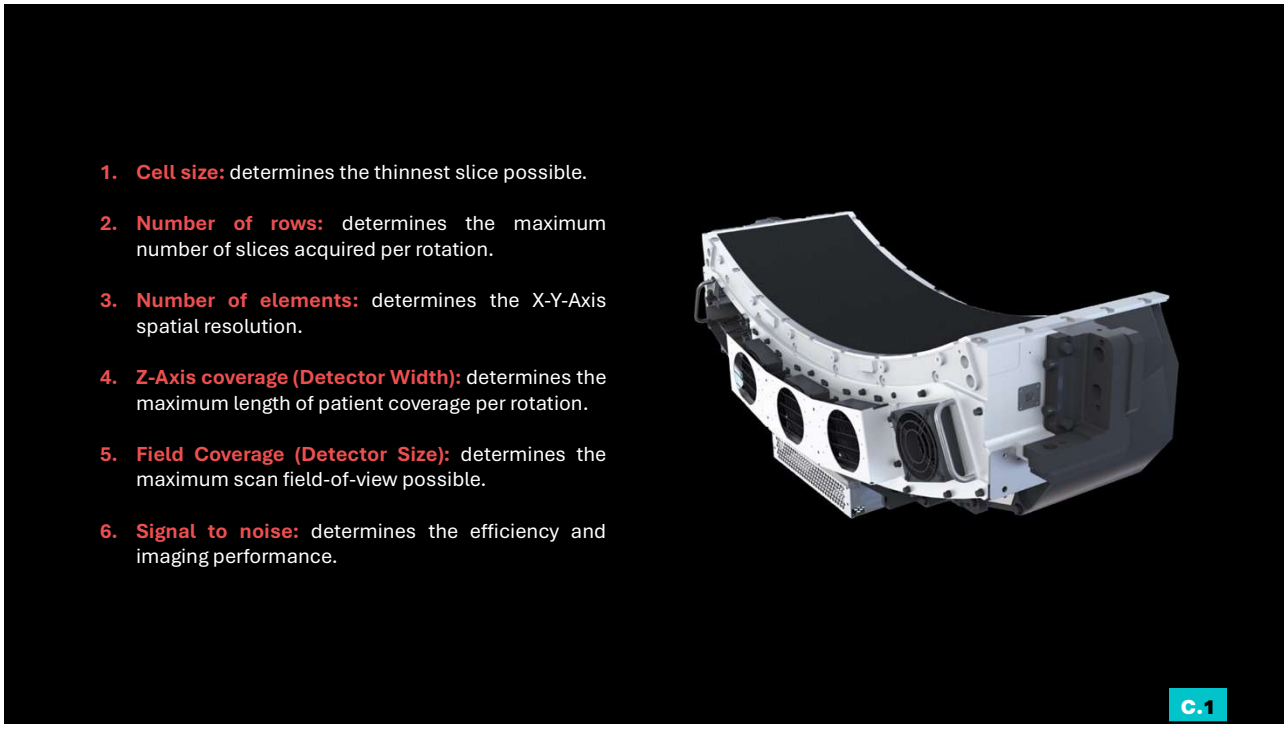


C.1

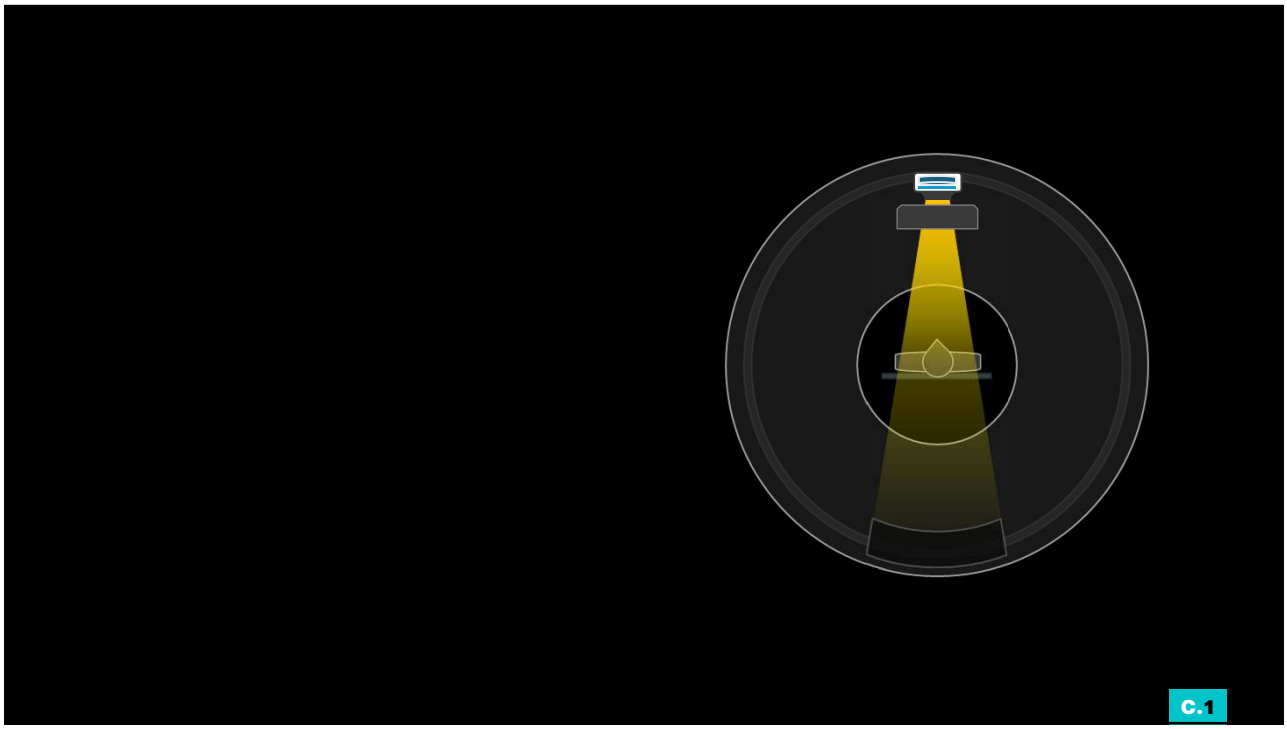
53


SFOV
The size of the detector (length of the detector along the X and Y Axis) determines the maximum scanning field of view; circle of overlapping projections at the iso-center of the gantry)
C.1

54


1. Cell size: determines the thinnest slice possible.
2. Number of rows: determines the maximum number of slices acquired per rotation.
3. Number of elements: determines the X-Y-Axis spatial resolution.
4. Z-Axis coverage (Detector Width): determines the maximum length of patient coverage per rotation.
5. Field Coverage (Detector Size): determines the maximum scan field-of-view possible.
6. Signal to noise: determines the efficiency and imaging performance.
C.1

55



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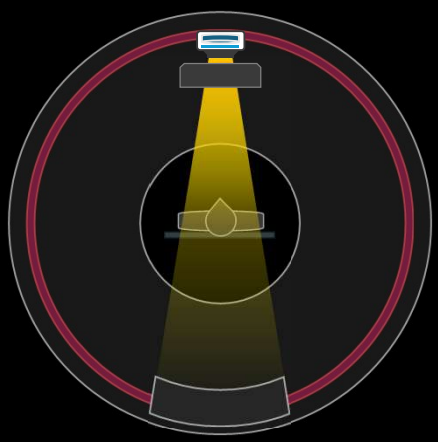
ROTATION SYS.

The rotation mechanism is responsible for how fast the CT scanner can complete an acquisition. It is generally referred to as “Rotation Speed”. It describes the **time it takes the X-Ray tube & Detector to complete one full rotation around the patient**.

Responsible for the scanner’s
“TEMPORAL RESOLUTION”



57

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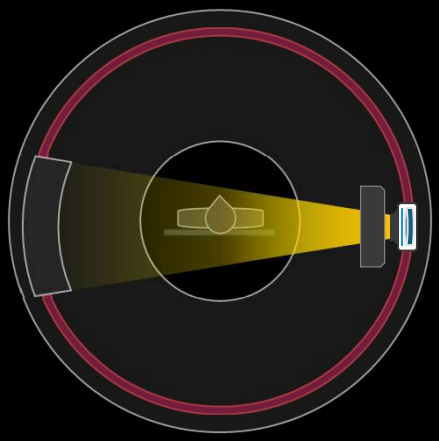

58

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Responsible for the scanner’s
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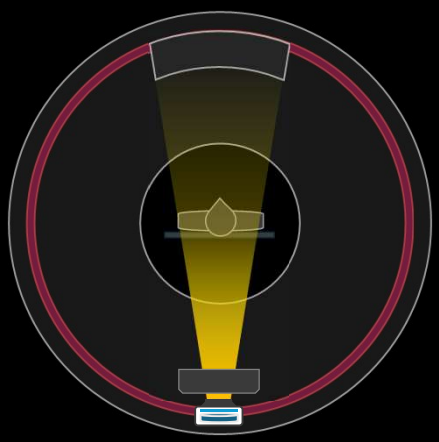

59

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Responsible for the scanner’s
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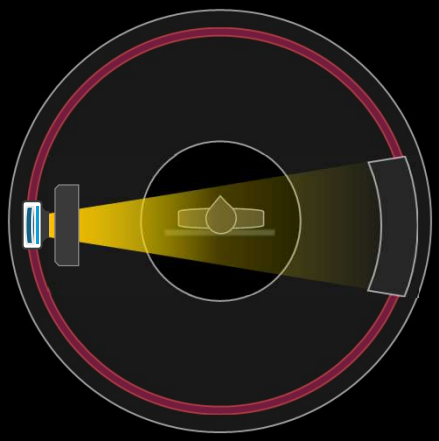

60

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Responsible for the scanner’s
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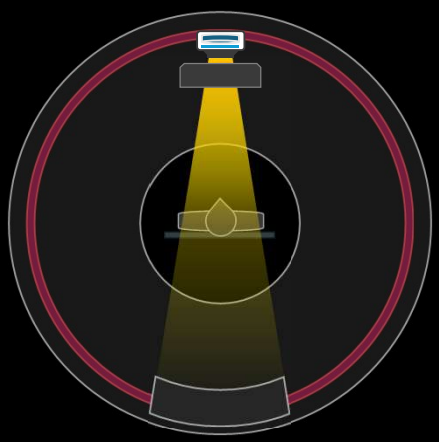
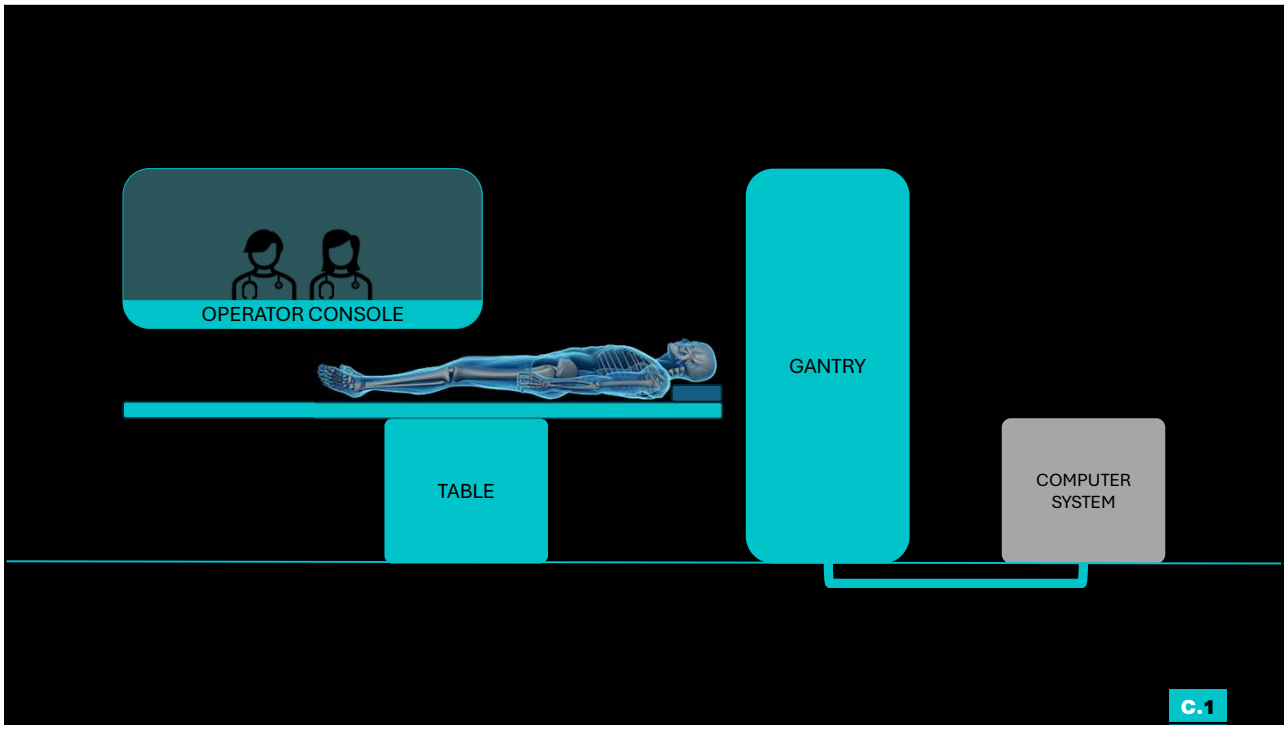
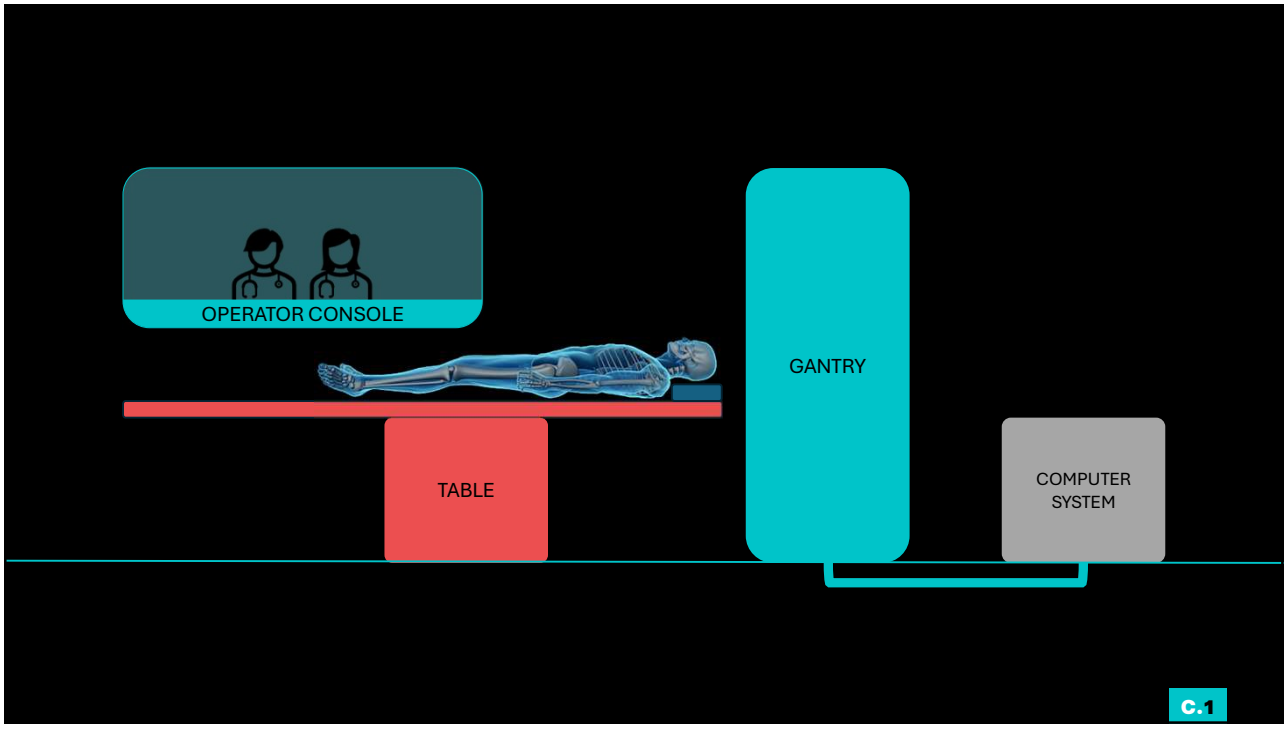


61


OPERATOR CONSOLE
GANTRY
TABLE
COMPUTER SYSTEM
C.1

62

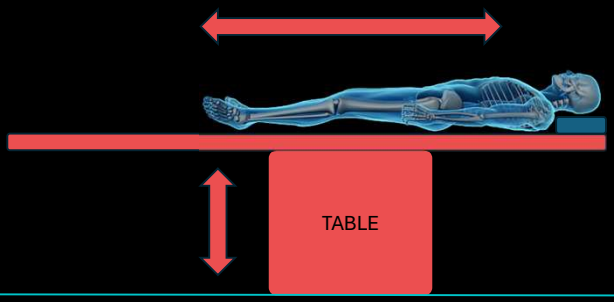

OPERATOR CONSOLE
GANTRY
TABLE
COMPUTER SYSTEM
C.1

63

PATIENT TABLE

The table is responsible for feeding the patient into the gantry during the scan.

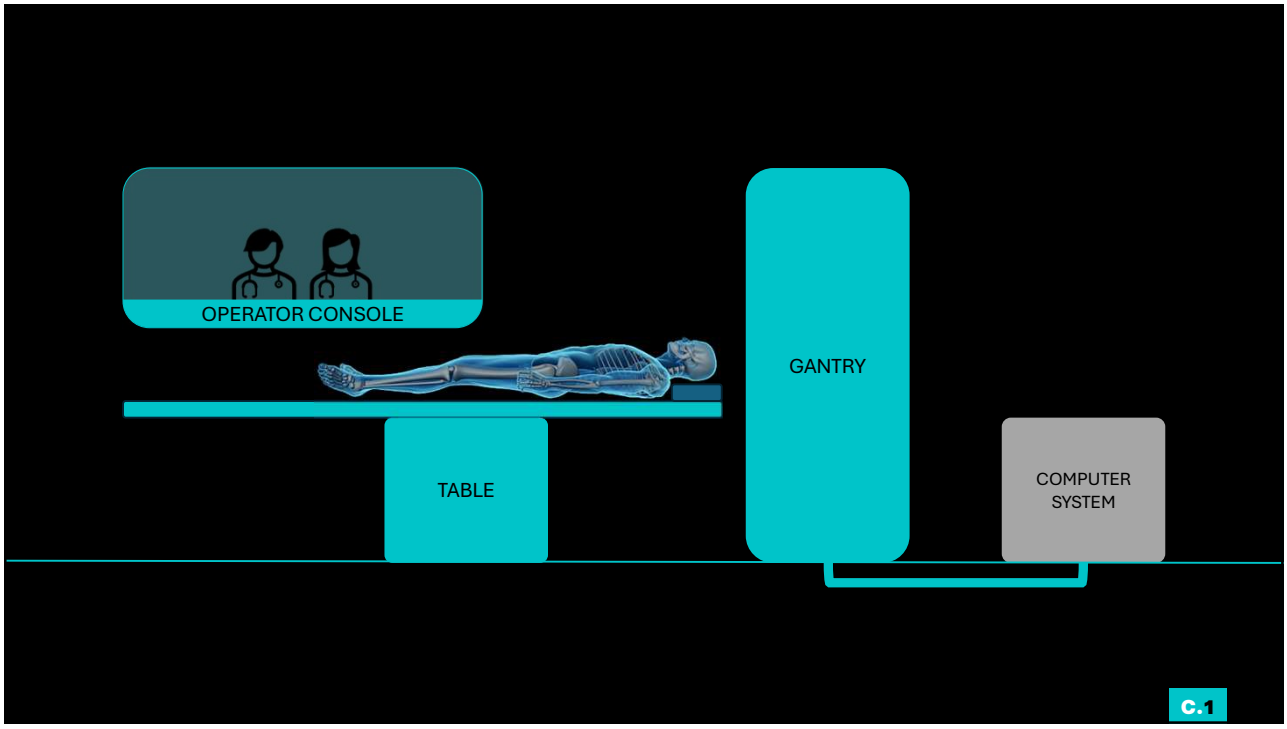
- Maximum patient weight allowed.
- Maximum scanning range.
- Maximum travel distance.
- Minimum table height possible.
- Lateral table movement (Some tables!)



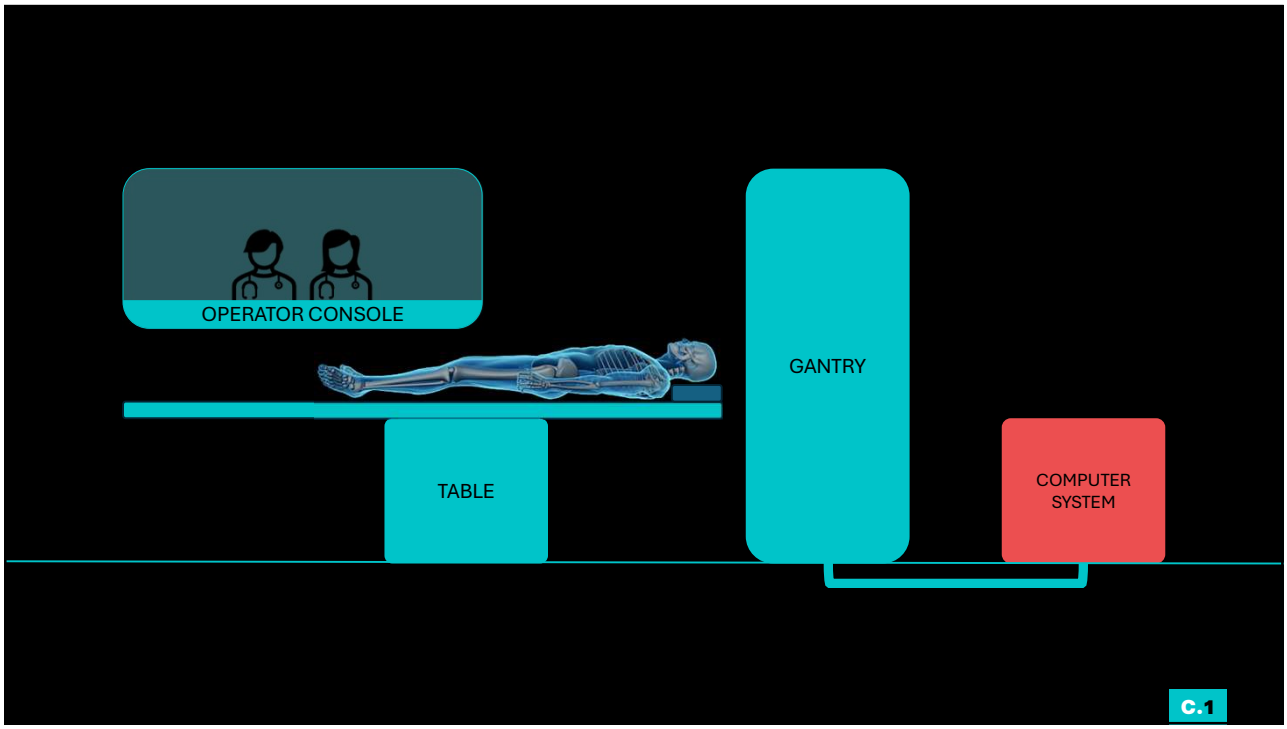
- **Scanning Range:** is the maximum patient length that can be scanned. (i.e. head to toe)
- **Travel Distance:** is the range of movement that the table can achieve in the horizontal plane (Z-Axis)

C.1

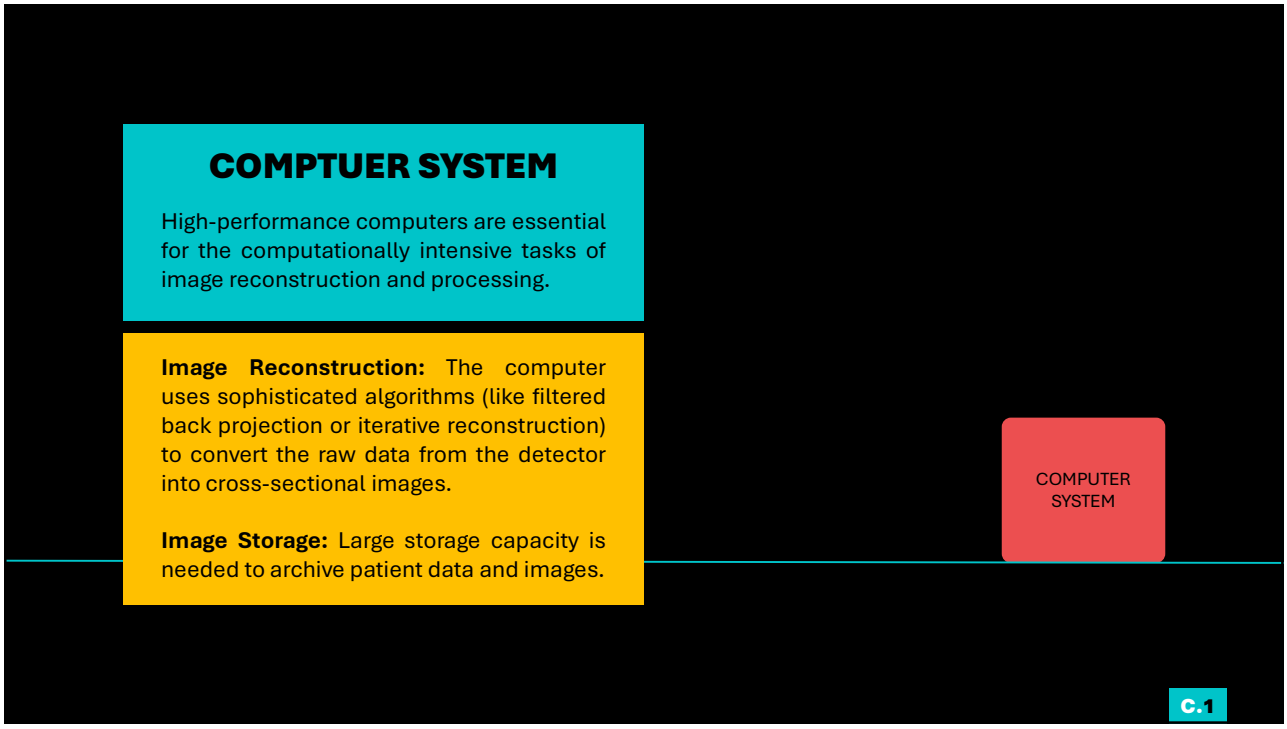
64



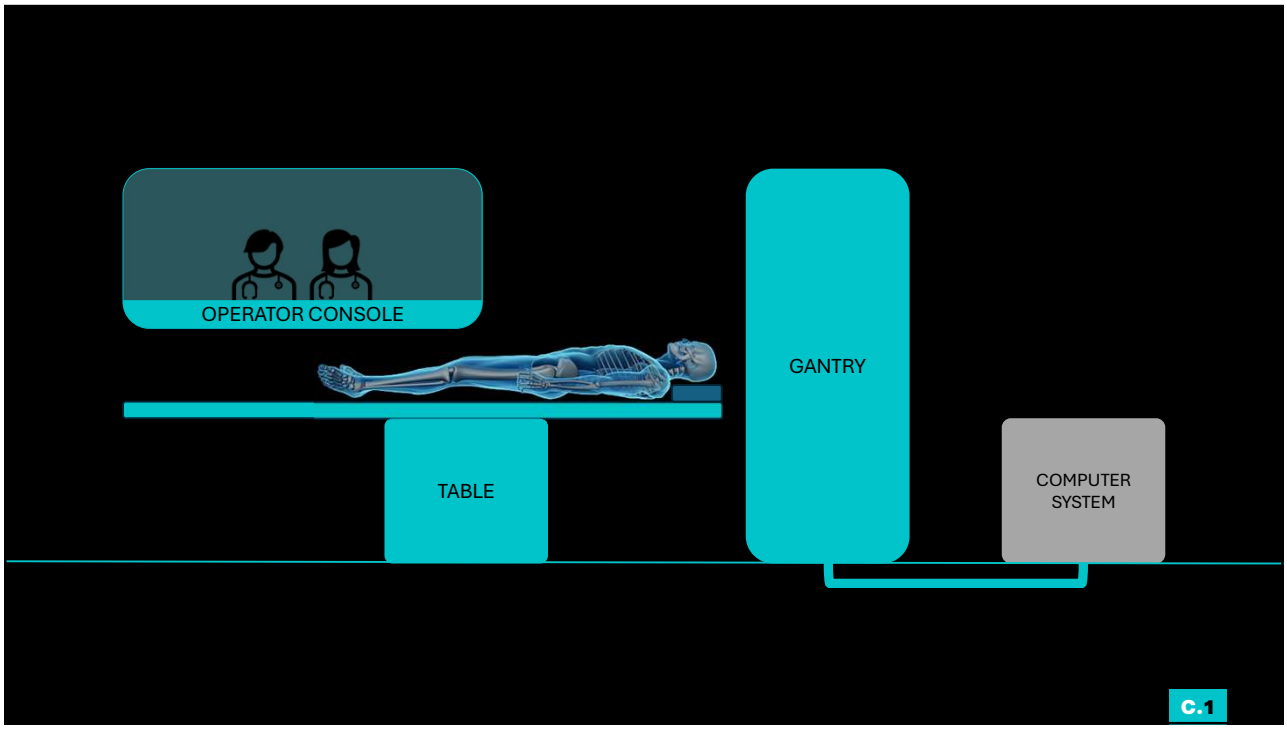
65


OPERATOR CONSOLE
GANTRY
TABLE
COMPUTER SYSTEM
C.1

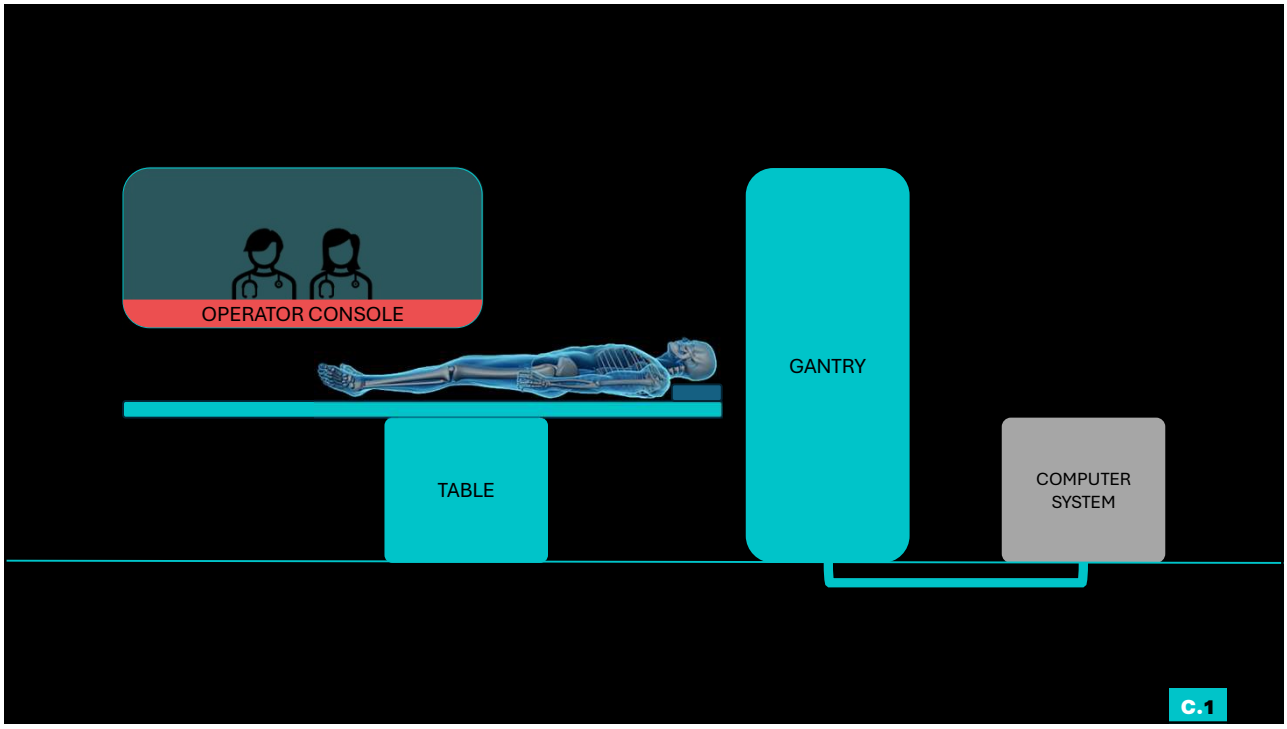
66


COMPTUER SYSTEM
High-performance computers are essential for the computationally intensive tasks of image reconstruction and processing.
Image Reconstruction: The computer uses sophisticated algorithms (like filtered back projection or iterative reconstruction) to convert the raw data from the detector into cross-sectional images.
Image Storage: Large storage capacity is needed to archive patient data and images.
COMPUTER SYSTEM
C.1

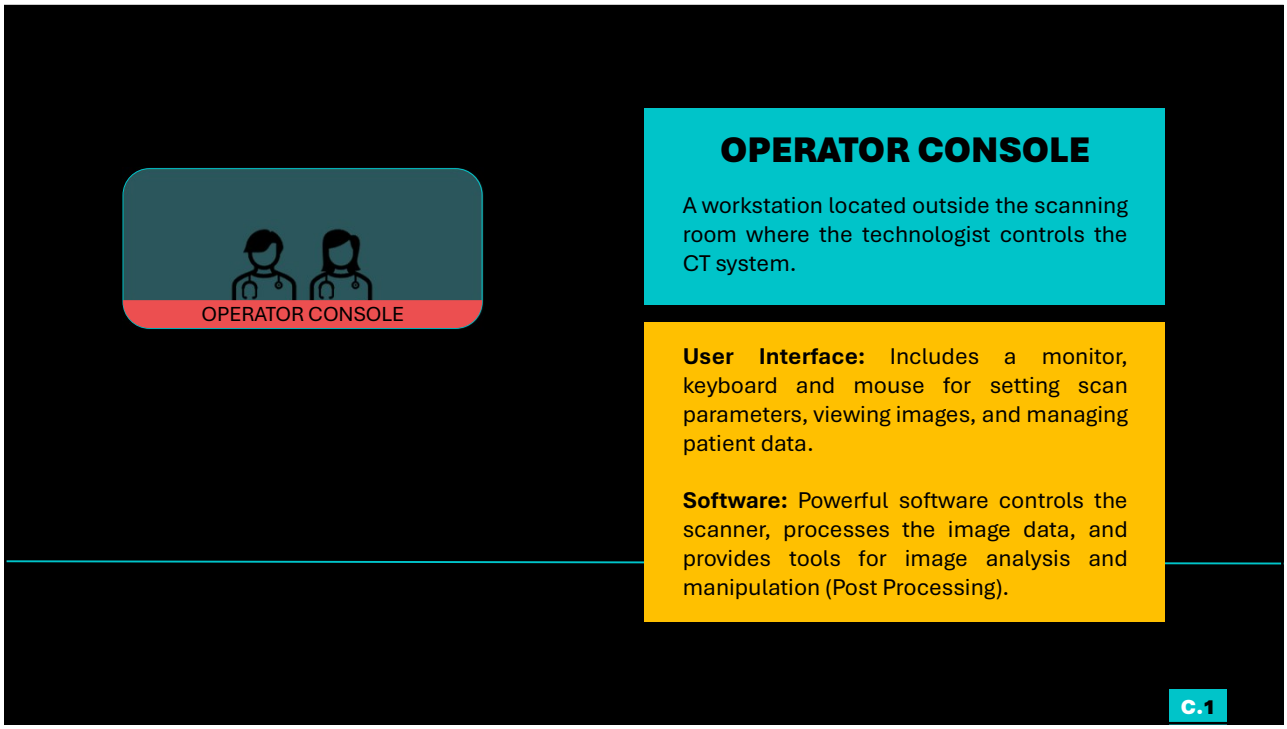
67


OPERATOR CONSOLE
GANTRY
TABLE
COMPUTER SYSTEM
C.1

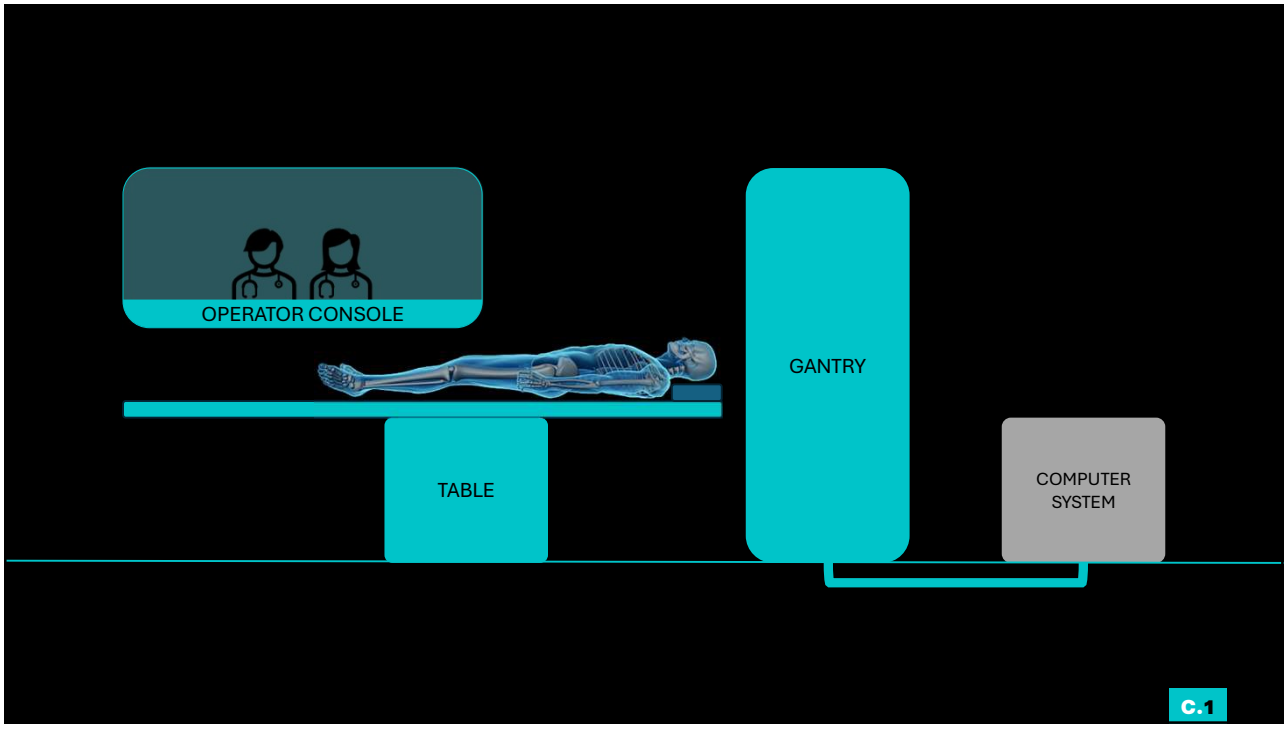
68


OPERATOR CONSOLE
GANTRY
TABLE
COMPUTER SYSTEM
C.1

69


OPERATOR CONSOLE
OPERATOR CONSOLE
A workstation located outside the scanning room where the technologist controls the CT system.
User Interface: Includes a monitor, keyboard and mouse for setting scan parameters, viewing images, and managing patient data.
Software: Powerful software controls the scanner, processes the image data, and provides tools for image analysis and manipulation (Post Processing).
C.1

70


OPERATOR CONSOLE
GANTRY
TABLE
COMPUTER SYSTEM
C.1

71


CHAPTER
ONE
OVERVIEW
KEY PRINCIPLES
TYPES & COMPONENTS
ACQUISITION MODES
IMAGE FORMATION

72


CHAPTER
ONE
OVERVIEW
KEY PRINCIPLES
TYPES & COMPONENTS
ACQUISITION MODES
IMAGE FORMATION

73

SCANOGRAM (SCOUT OR LOCALIZER)

AXIAL (STEP & SHOOT)

The scan is performed sequentially one acquisition (exposure) at a time. The beam is turned on and off with table movement between exposures.

HELICAL (SPIRAL)

The scan is performed as one continuous exposure. The tube/detector constantly rotates and expose the patient while the table is constantly moves into the gantry

VOLUME

One shot exposure of an area of the patient (no table movement). The maximum possible size of the area is limited to the width of the detector in the Z-axis

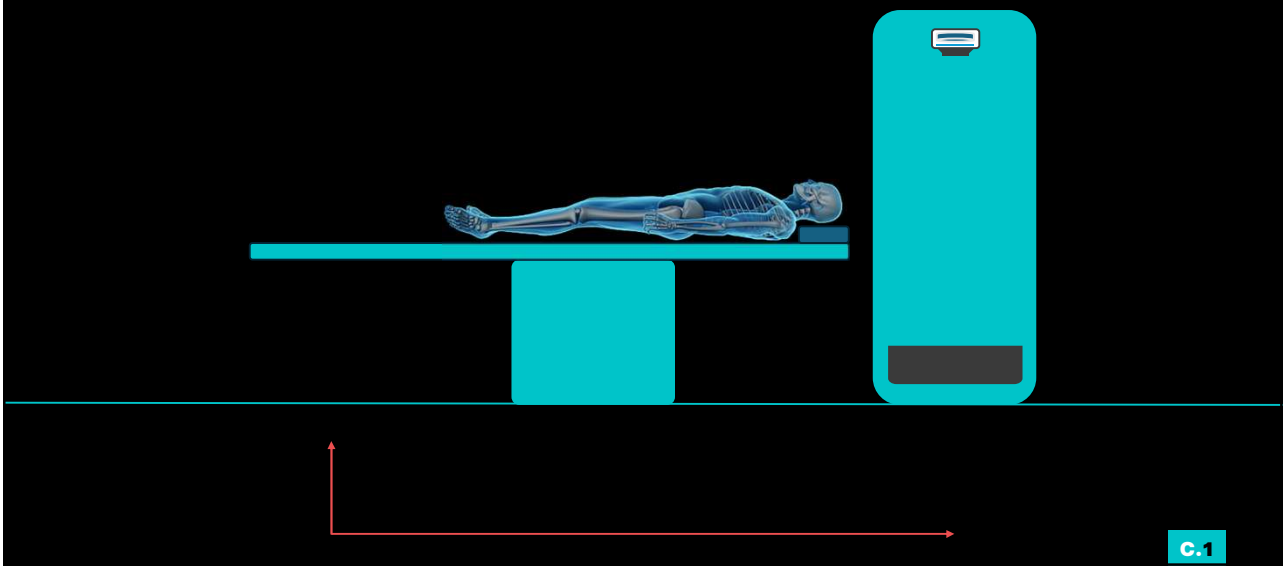
DYNAMIC (CINE)

A continuous exposure or multiple exposures of an area of the patient (no table movement). Used for evaluation physiological evaluations.

C.1

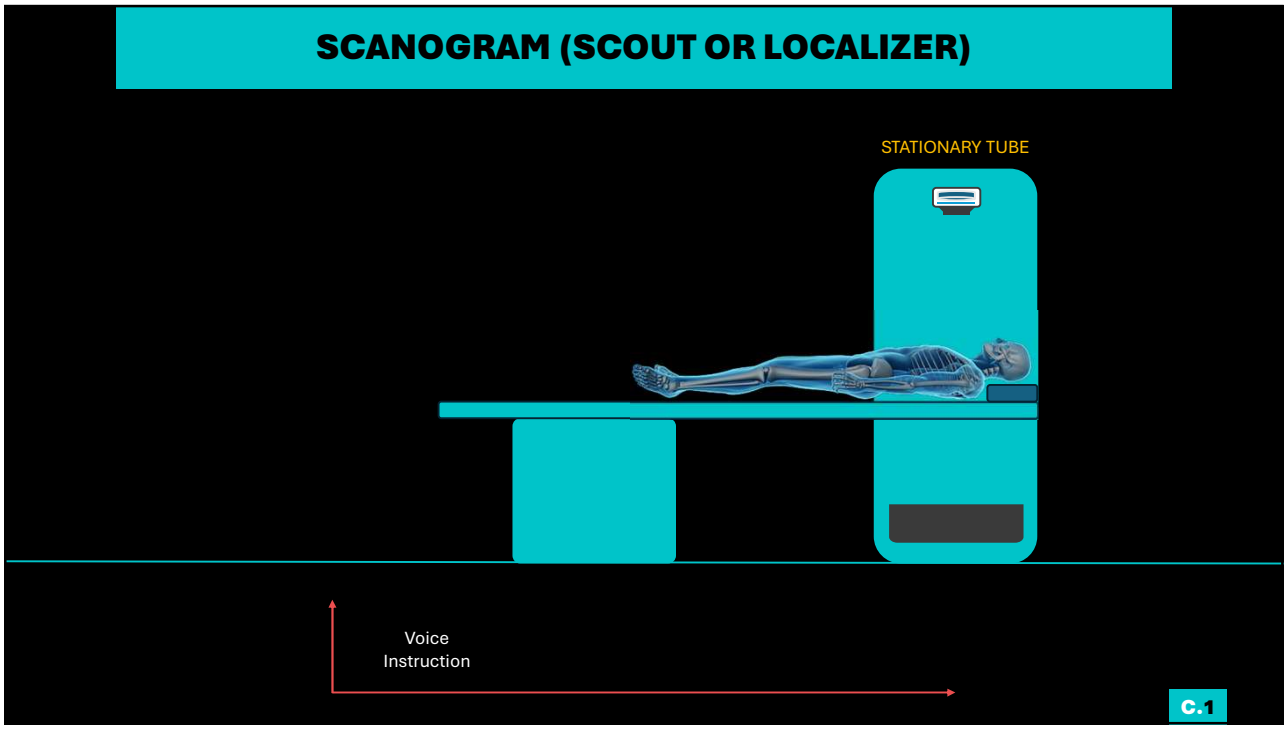
74

SCANOGRAM (SCOUT OR LOCALIZER)

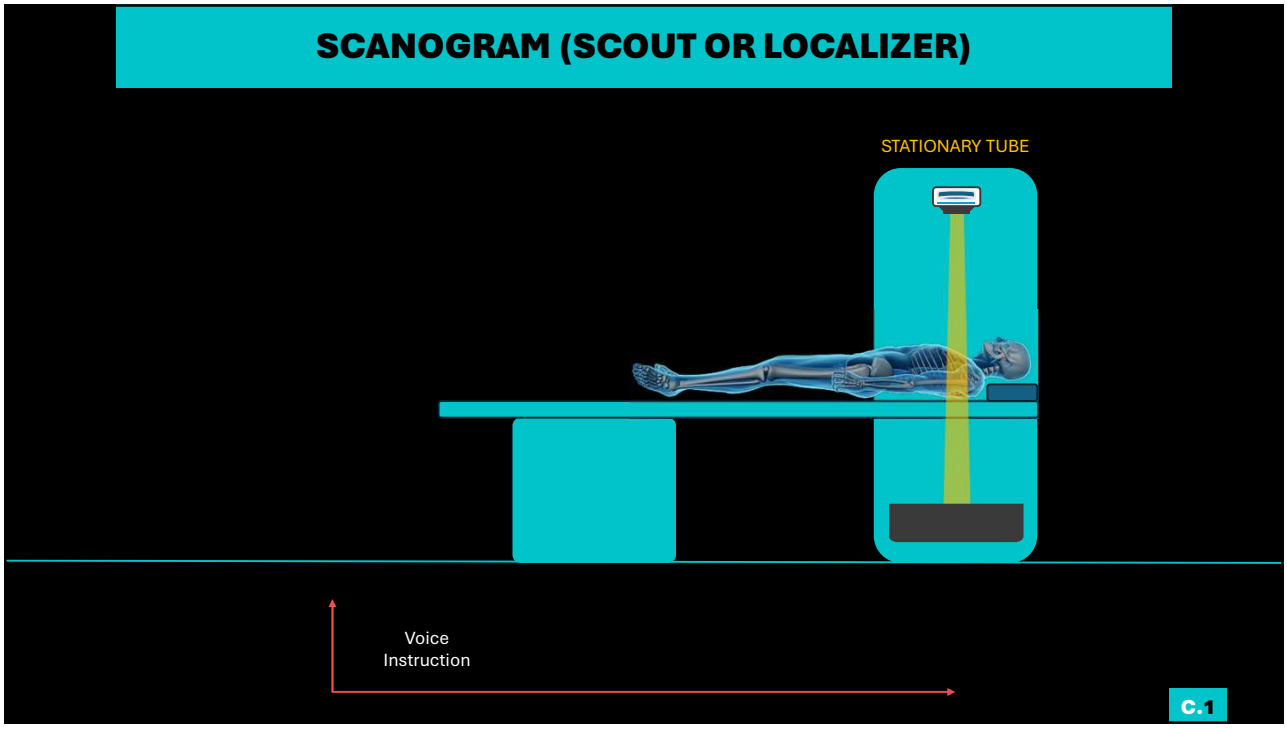


C.1

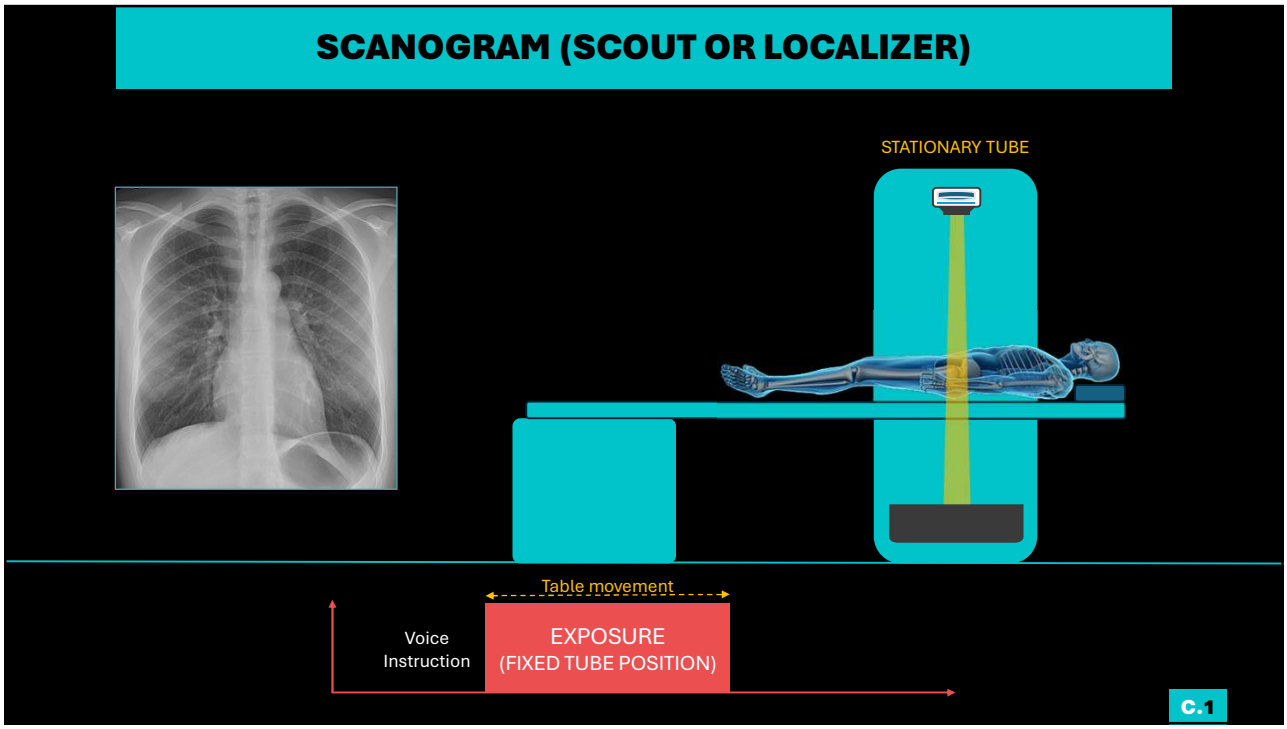
75


SCANOGRAM (SCOUT OR LOCALIZER)
STATIONARY TUBE
Voice
Instruction
C.1

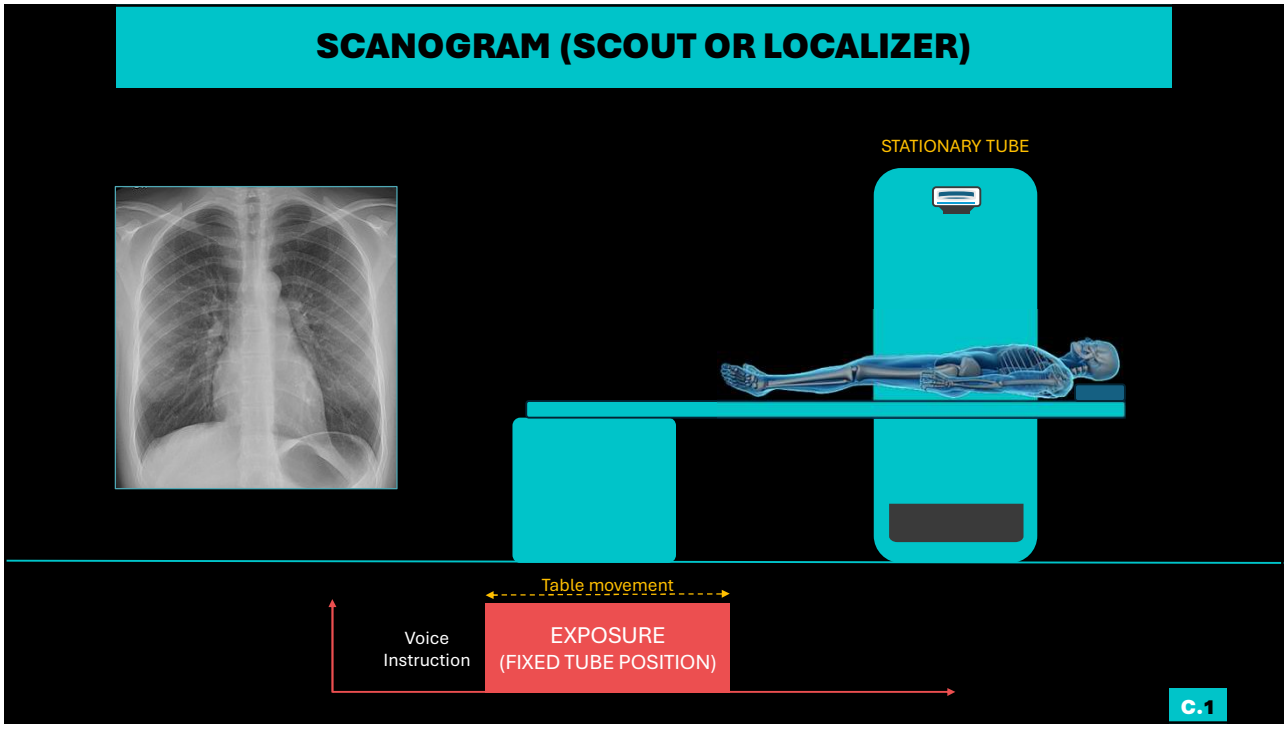
76


SCANOGRAM (SCOUT OR LOCALIZER)
STATIONARY TUBE
Voice
Instruction
C.1

77

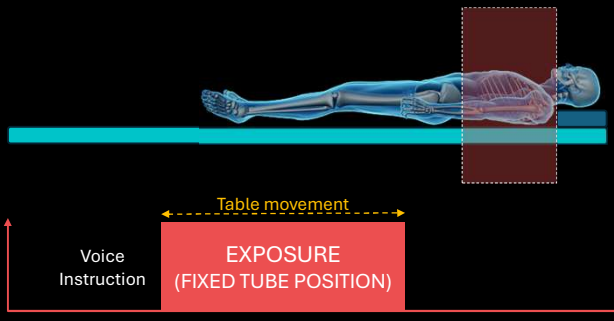

SCANOGRAM (SCOUT OR LOCALIZER)
STATIONARY TUBE
Table movement
Voice Instruction
EXPOSURE
(FIXED TUBE POSITION)
C.1

78


SCANOGRAM (SCOUT OR LOCALIZER)
STATIONARY TUBE
Table movement
Voice Instruction
EXPOSURE
(FIXED TUBE POSITION)
C.1

79

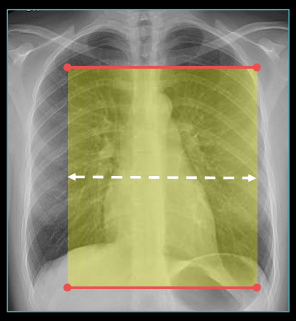
SCANOGRAM (SCOUT OR LOCALIZER)



C.1

80

SCANOGRAM (SCOUT OR LOCALIZER)



Scanogram: The scout (localizer) is a 2D radiograph acquired at the beginning of most CT procedures. It is done using a fixed X-Ray tube. The beam is turned on, continuously exposing the patient while moving the table into the gantry. The scout is used as a guide to plan the CT procedure. (Start location, End location, FOV)

C.1

81

SCANOGRAM (SCOUT OR LOCALIZER)

AXIAL (STEP & SHOOT)

The scan is performed sequentially one acquisition (exposure) at a time. The beam is turned on and off with table movement between exposures.

HELICAL (SPIRAL)

The scan is performed as one continuous exposure. The tube/detector constantly rotates and expose the patient while the table is constantly moves into the gantry

VOLUME

One shot exposure of an area of the patient (no table movement). The maximum possible size of the area is limited to the width of the detector in the Z-axis

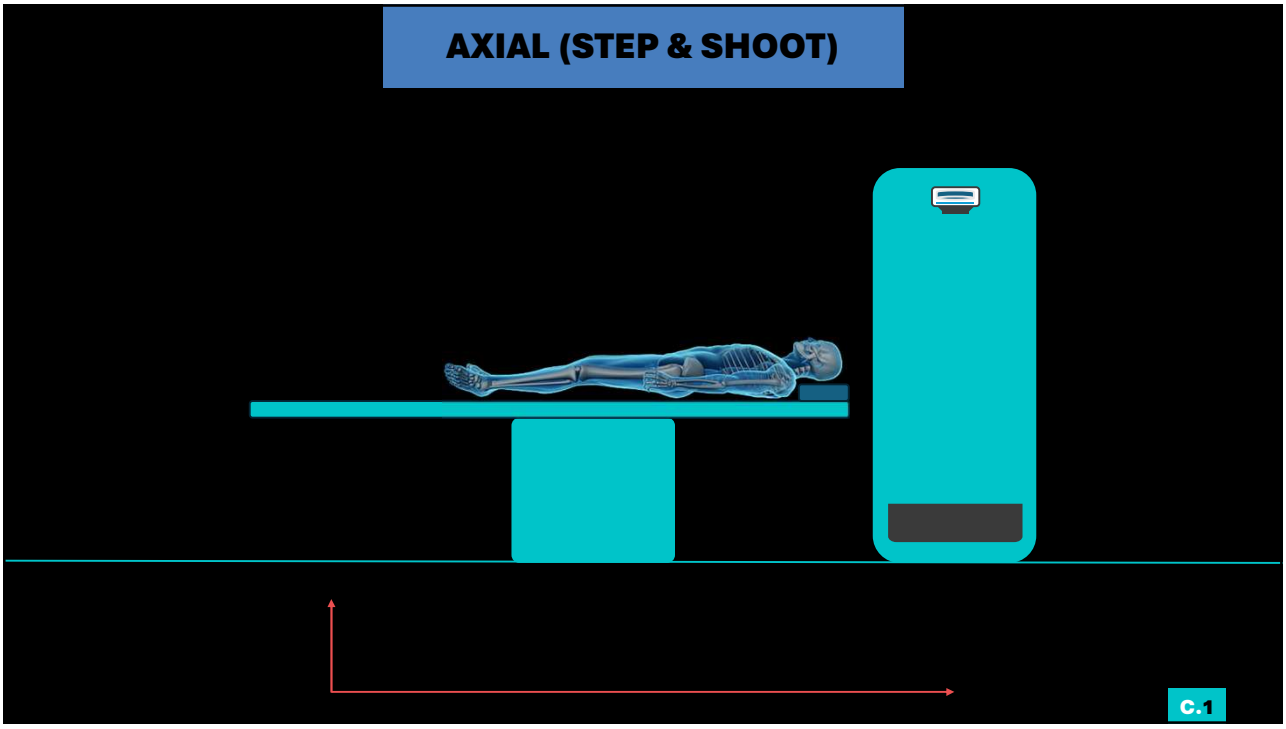
DYNAMIC (CINE)

A continuous exposure or multiple exposures of an area of the patient (no table movement). Used for evaluation physiological evaluations.

C.1

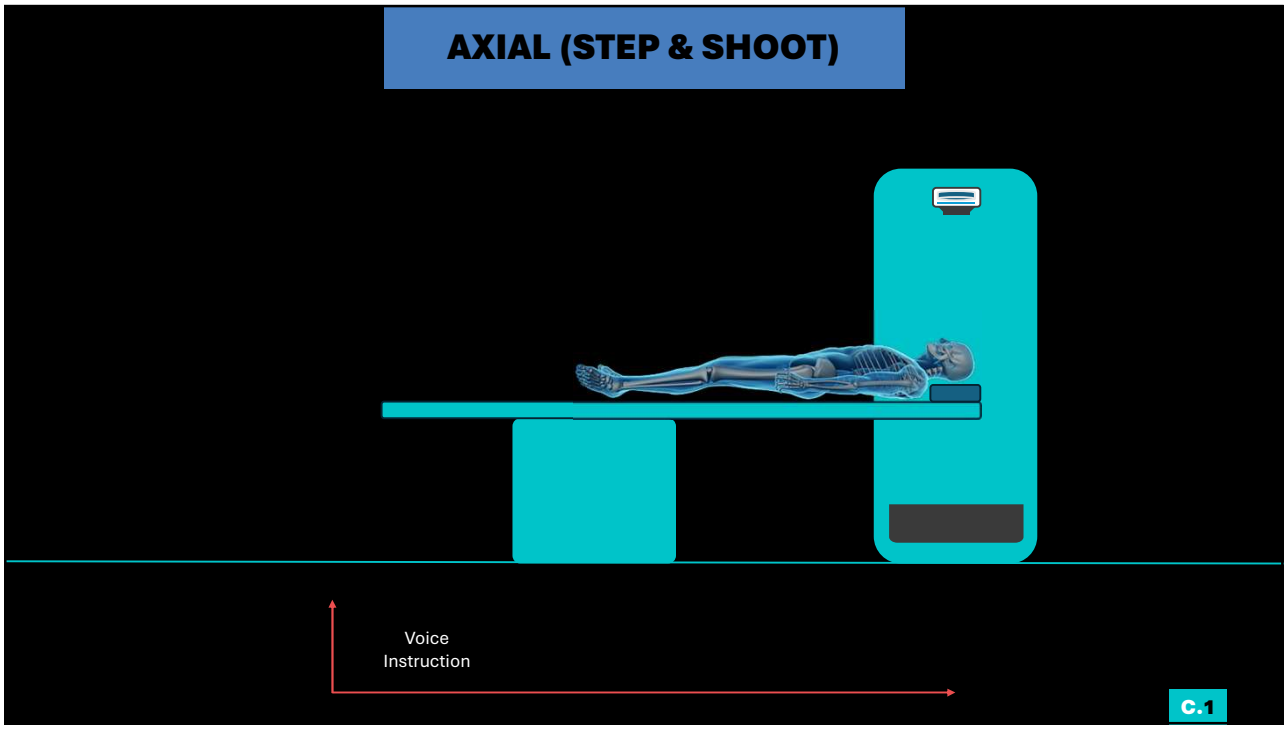
82

AXIAL (STEP & SHOOT)

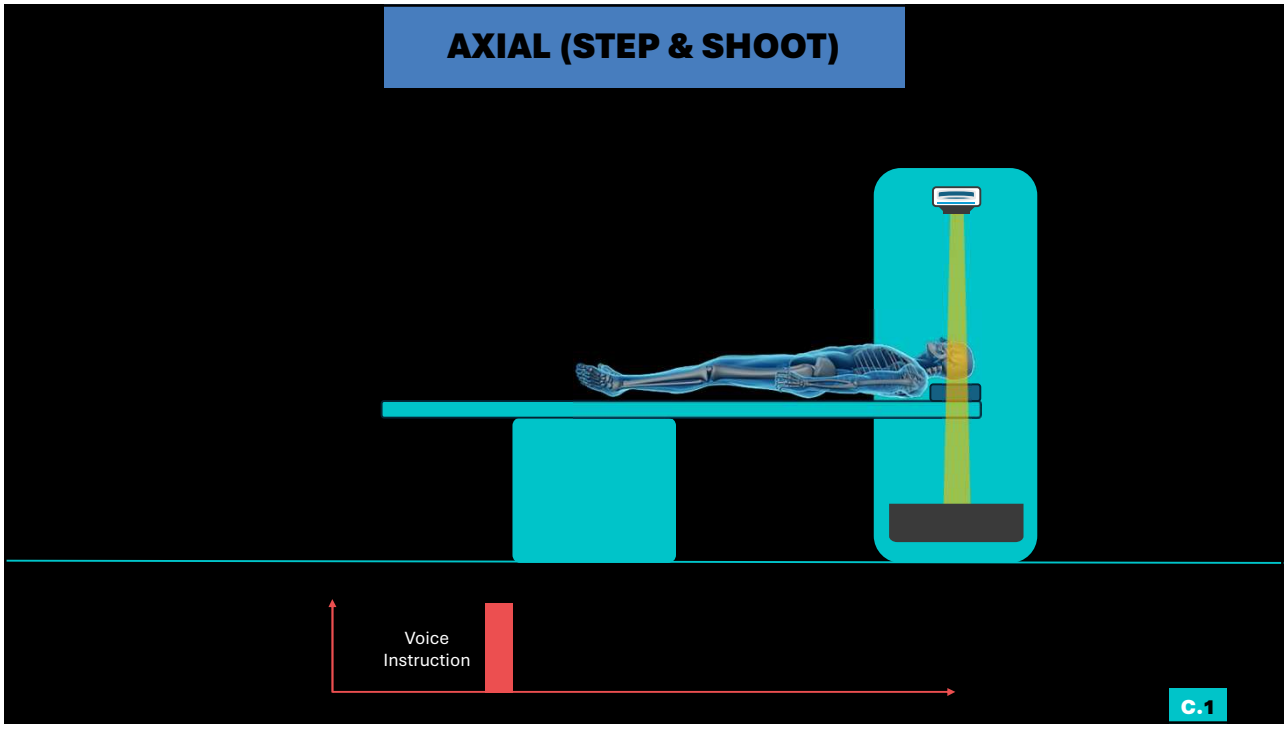


C.1

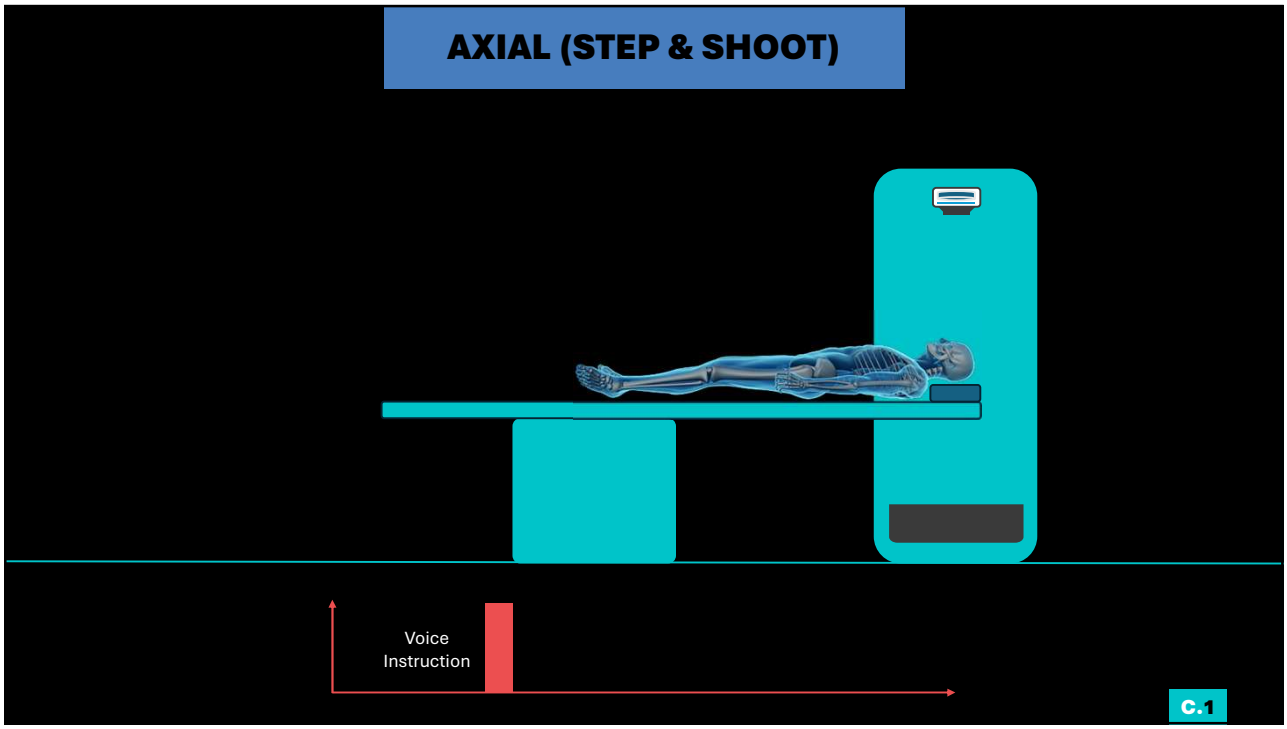
83


AXIAL (STEP & SHOOT)
Voice
Instruction
C.1

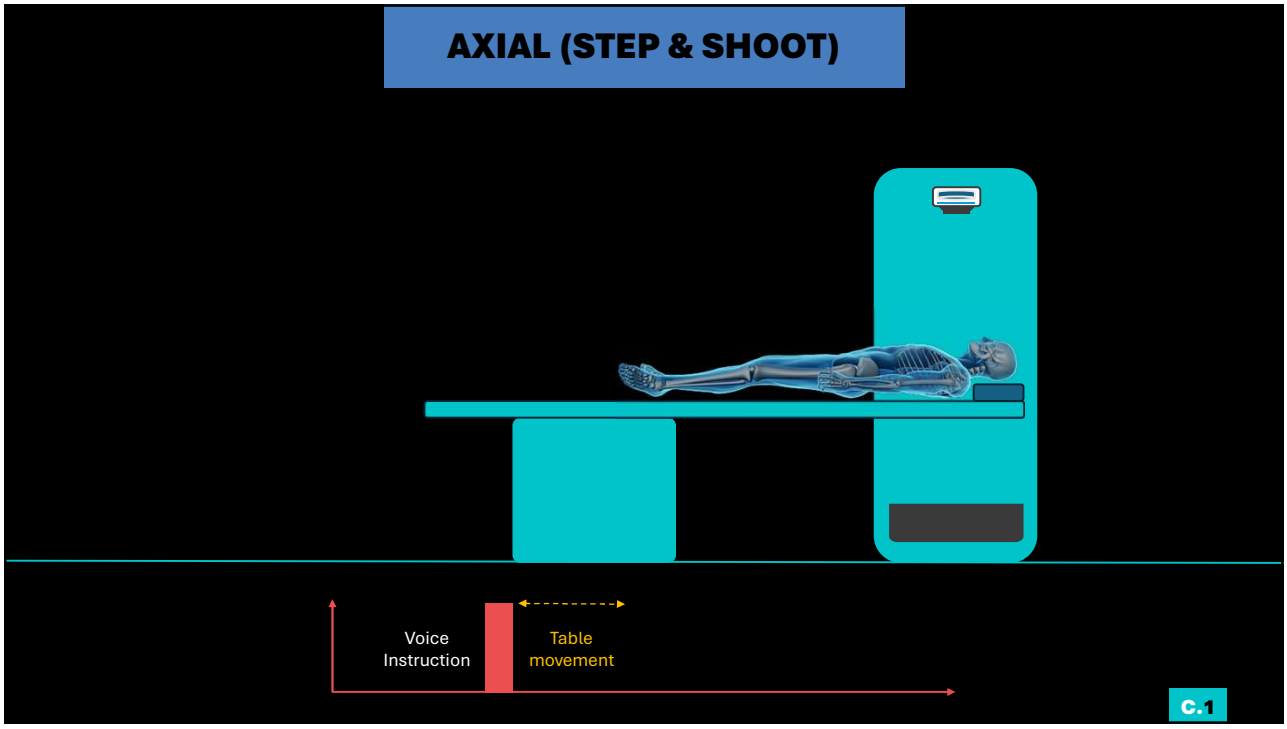
84


AXIAL (STEP & SHOOT)
Voice
Instruction
C.1

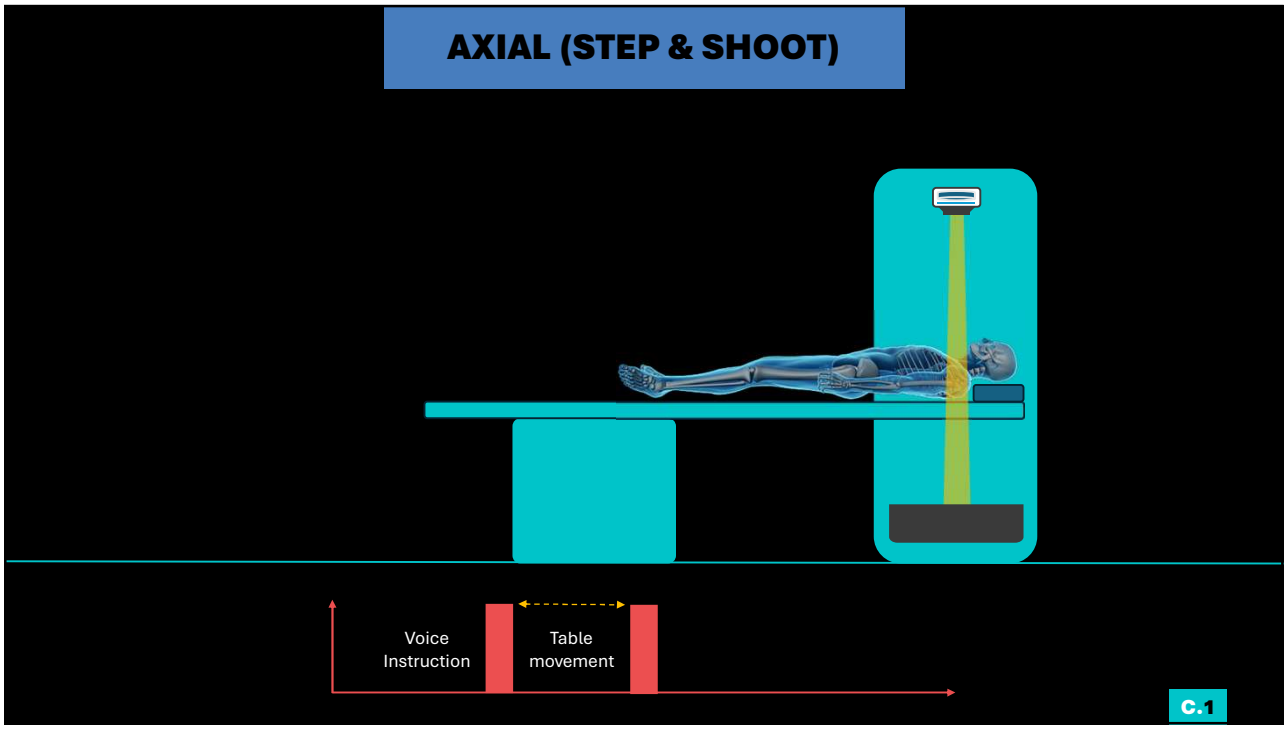
85


AXIAL (STEP & SHOOT)
Voice
Instruction
C.1

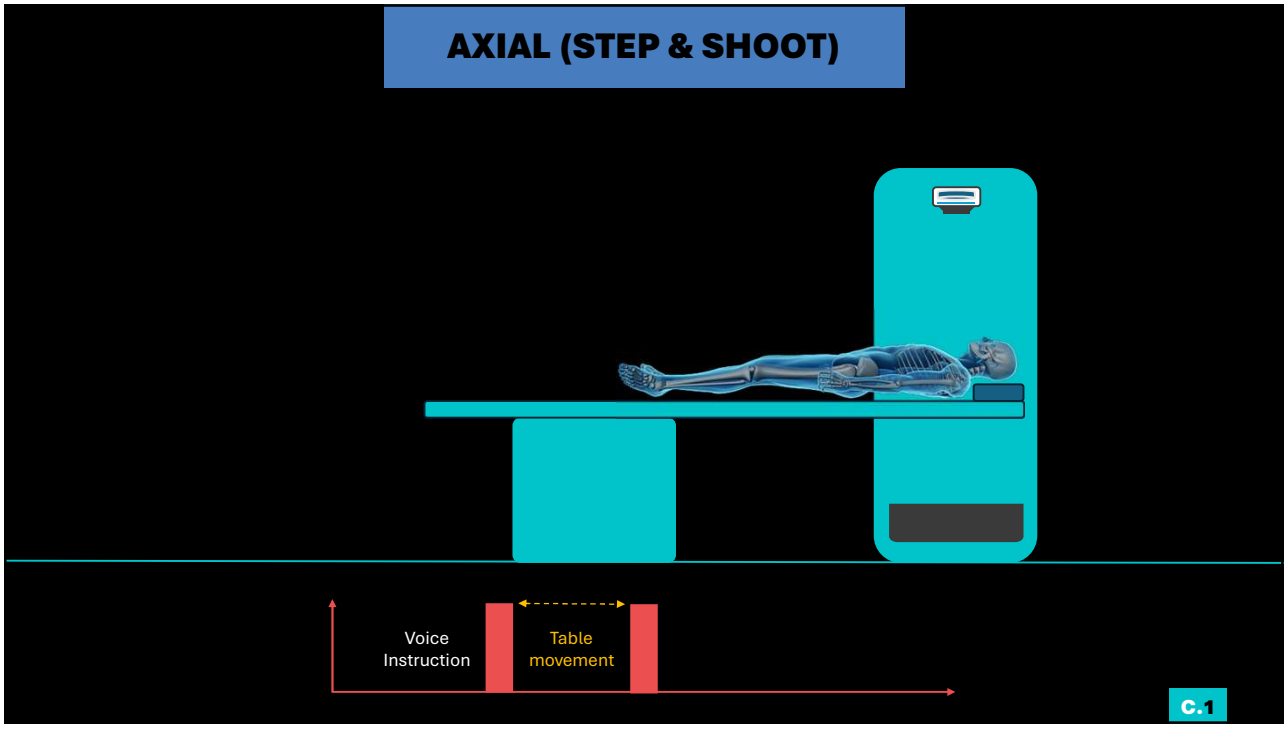
86


AXIAL (STEP & SHOOT)
Voice
Instruction
Table
movement
C.1

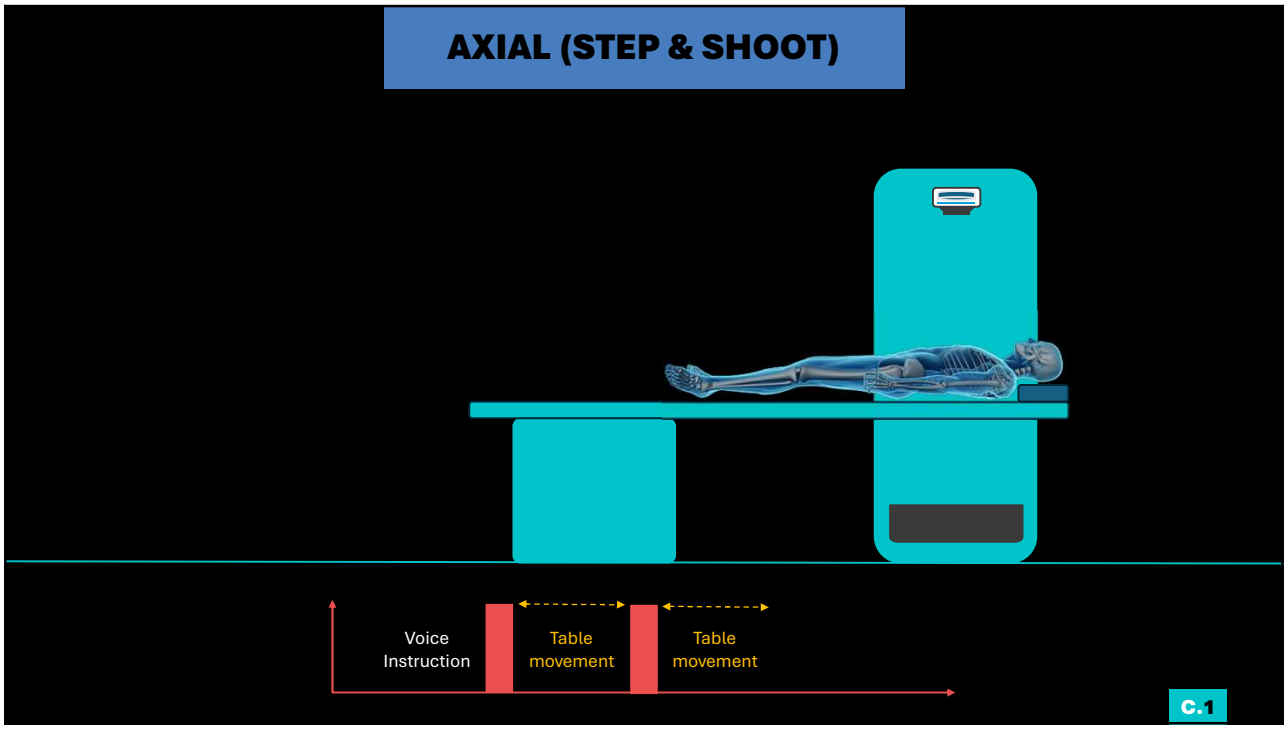
87


AXIAL (STEP & SHOOT)
Voice Instruction
Table movement
C.1

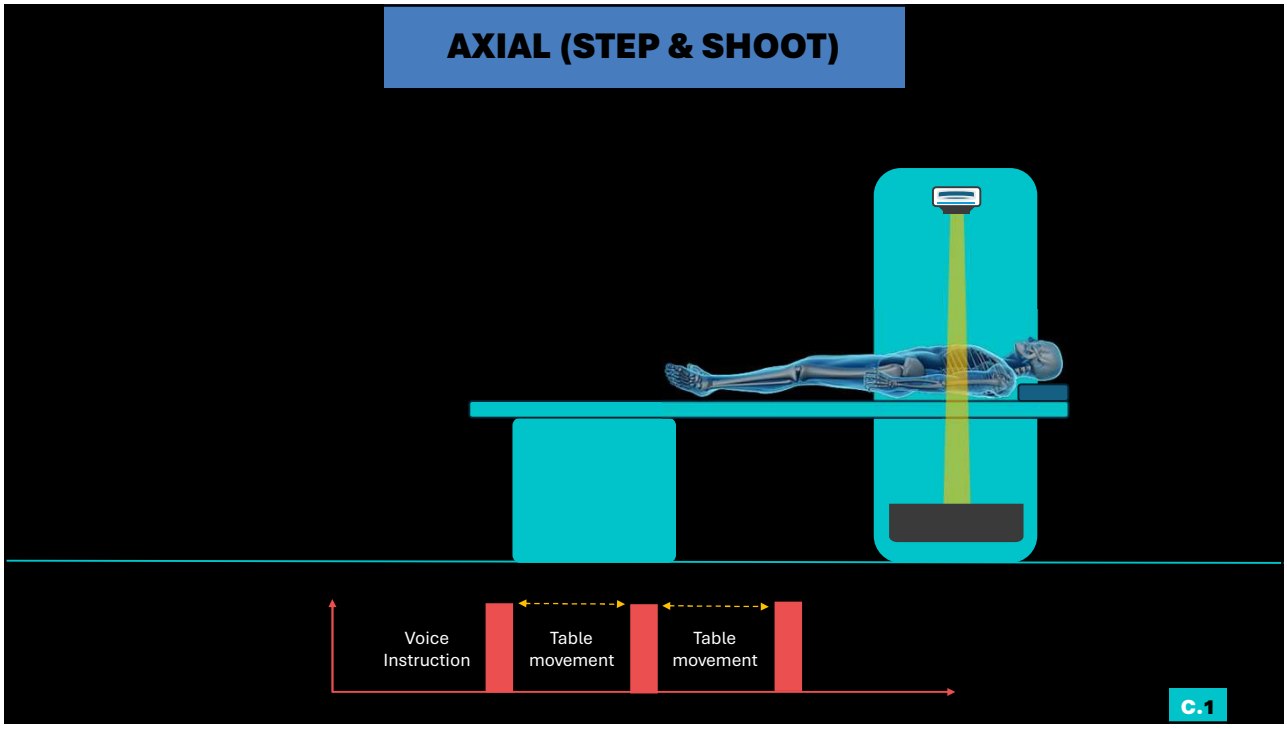
88


AXIAL (STEP & SHOOT)
Voice Instruction
Table movement
C.1

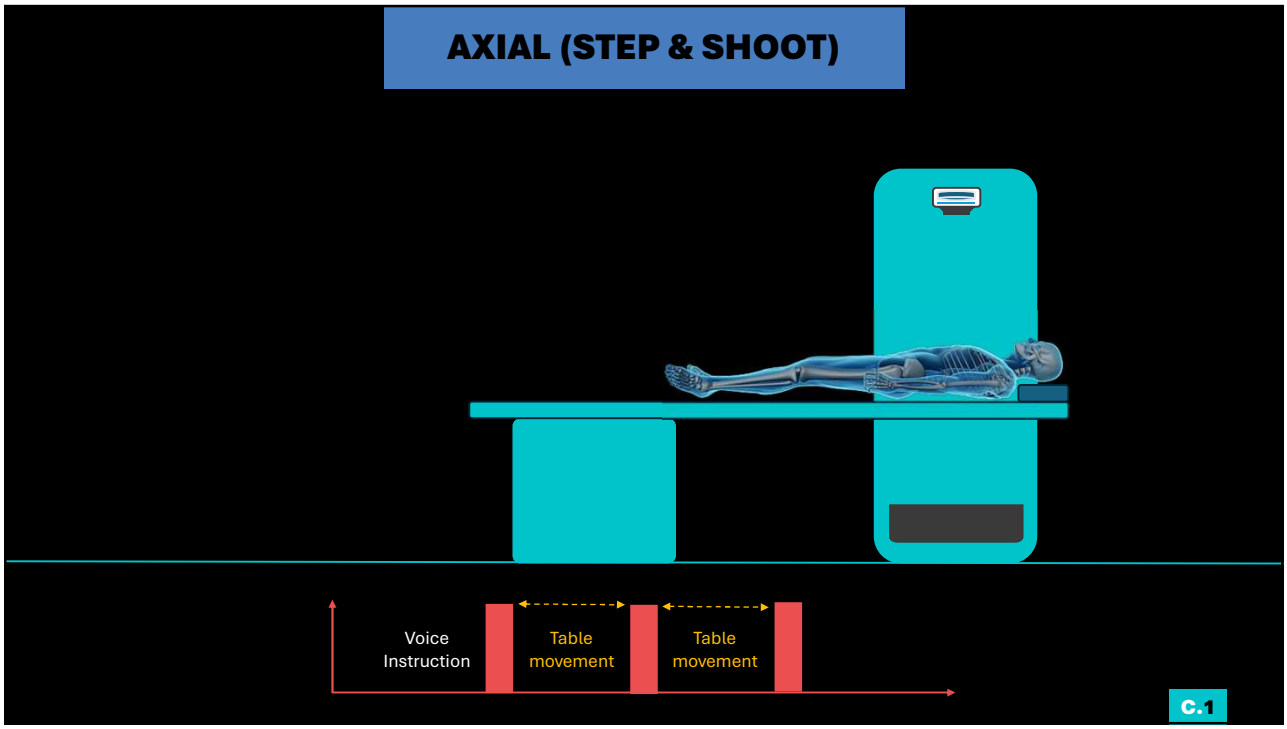
89


AXIAL (STEP & SHOOT)
Voice Instruction
Table movement
Table movement
C.1

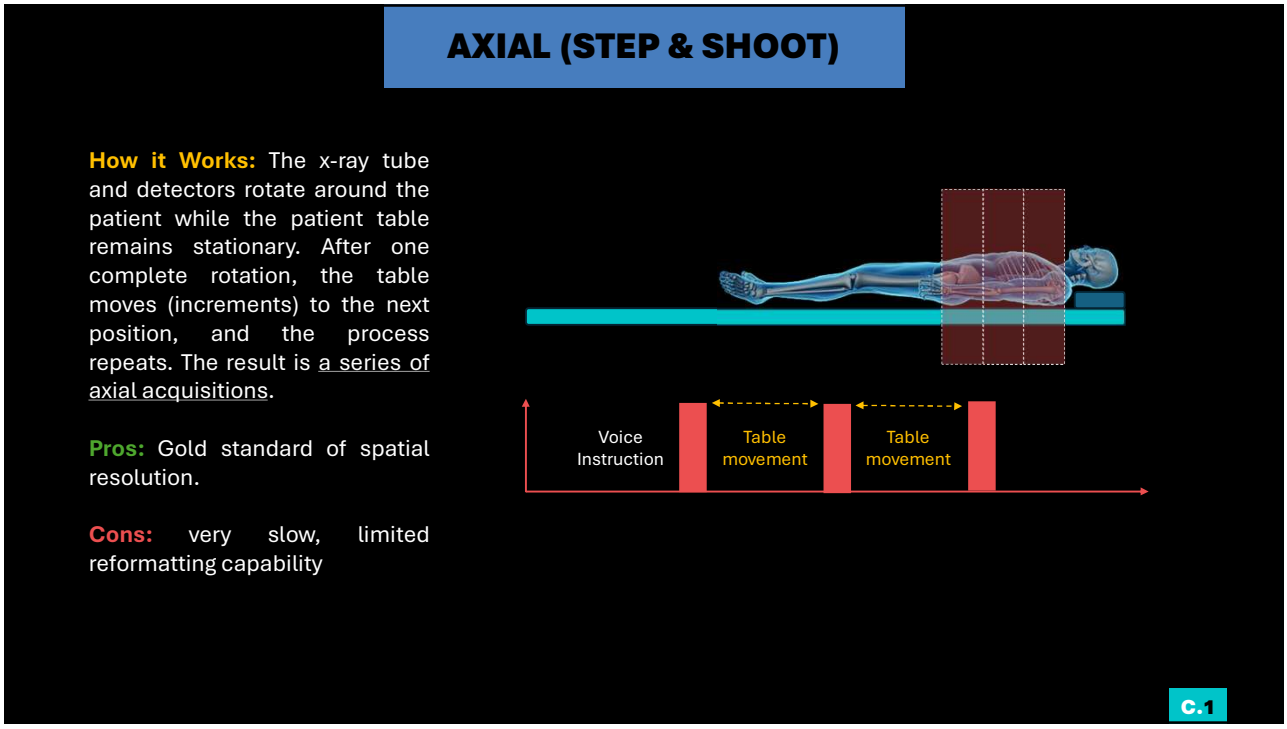
90


AXIAL (STEP & SHOOT)
Voice Instruction
Table movement
Table movement
C.1

91


AXIAL (STEP & SHOOT)
Voice Instruction
Table movement
Table movement
C.1

92


AXIAL (STEP & SHOOT)
How it Works: The x-ray tube and detectors rotate around the patient while the patient table remains stationary. After one complete rotation, the table moves (increments) to the next position, and the process repeats. The result is a series of axial acquisitions.
Pros: Gold standard of spatial resolution.
Cons: very slow, limited reformatting capability
Voice Instruction
Table movement
Table movement
C.1

93

SCANOGRAM (SCOUT OR LOCALIZER)

AXIAL (STEP & SHOOT)

The scan is performed sequentially one acquisition (exposure) at a time. The beam is turned on and off with table movement between exposures.

HELICAL (SPIRAL)

The scan is performed as one continuous exposure. The tube/detector constantly rotates and expose the patient while the table is constantly moves into the gantry

VOLUME

One shot exposure of an area of the patient (no table movement). The maximum possible size of the area is limited to the width of the detector in the Z-axis

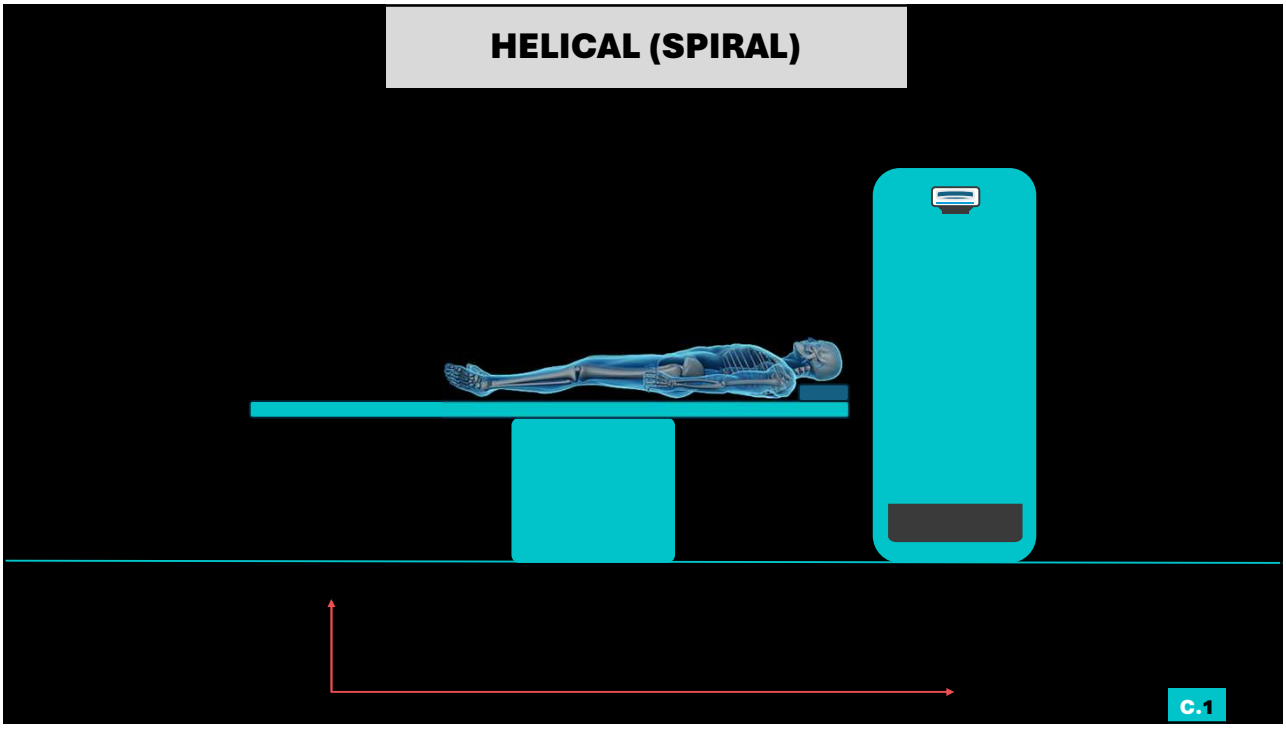
DYNAMIC (CINE)

A continuous exposure or multiple exposures of an area of the patient (no table movement). Used for evaluation physiological evaluations.

C.1

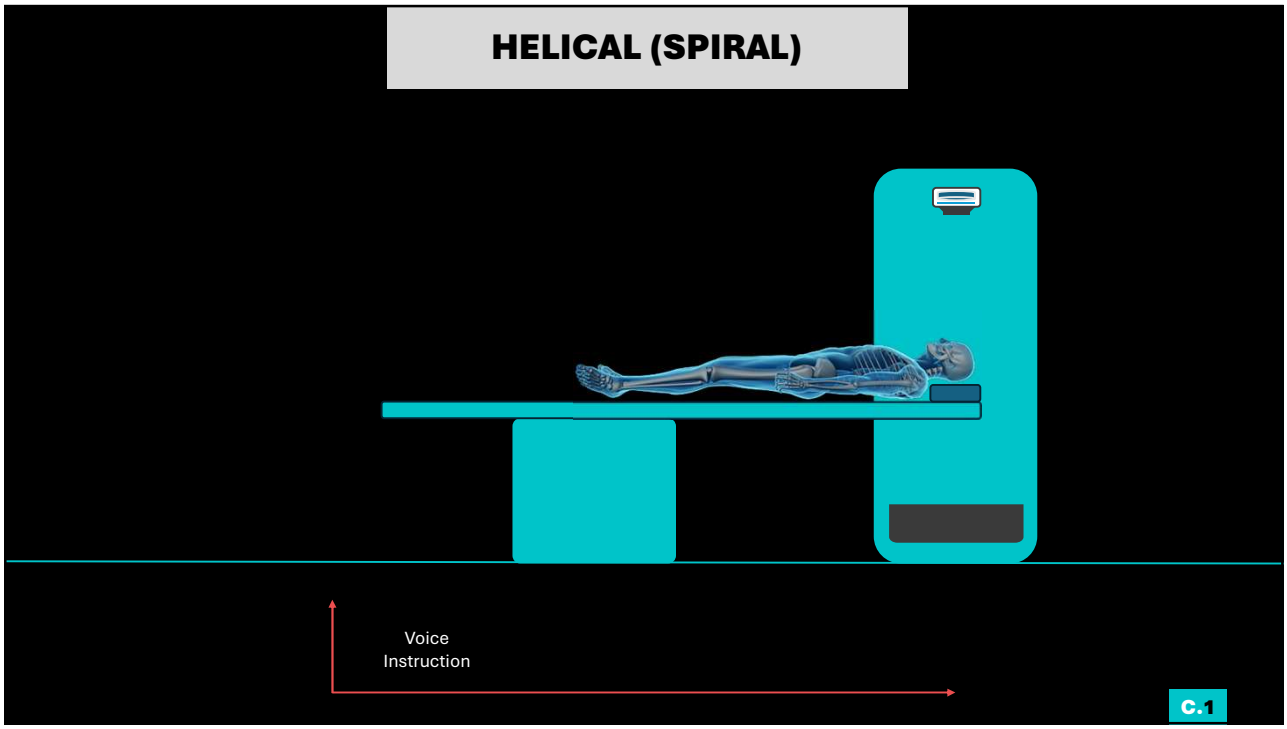
94

HELICAL (SPIRAL)

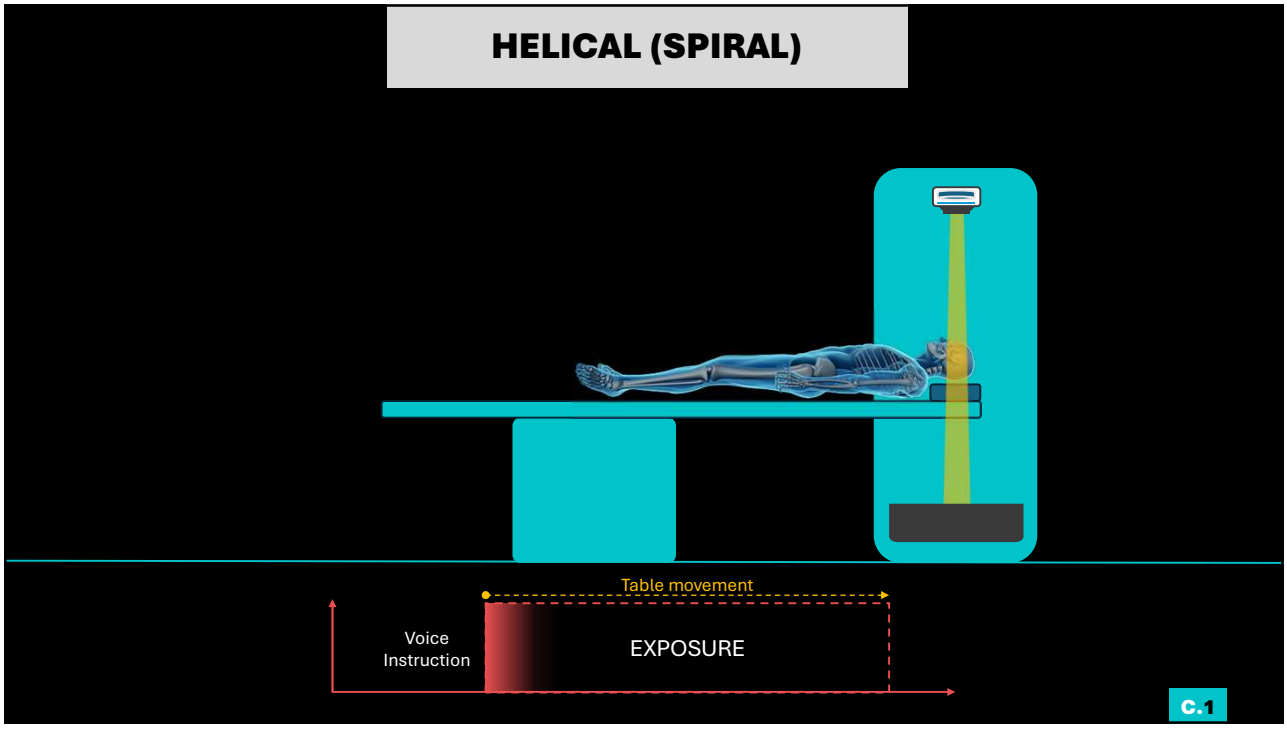


C.1

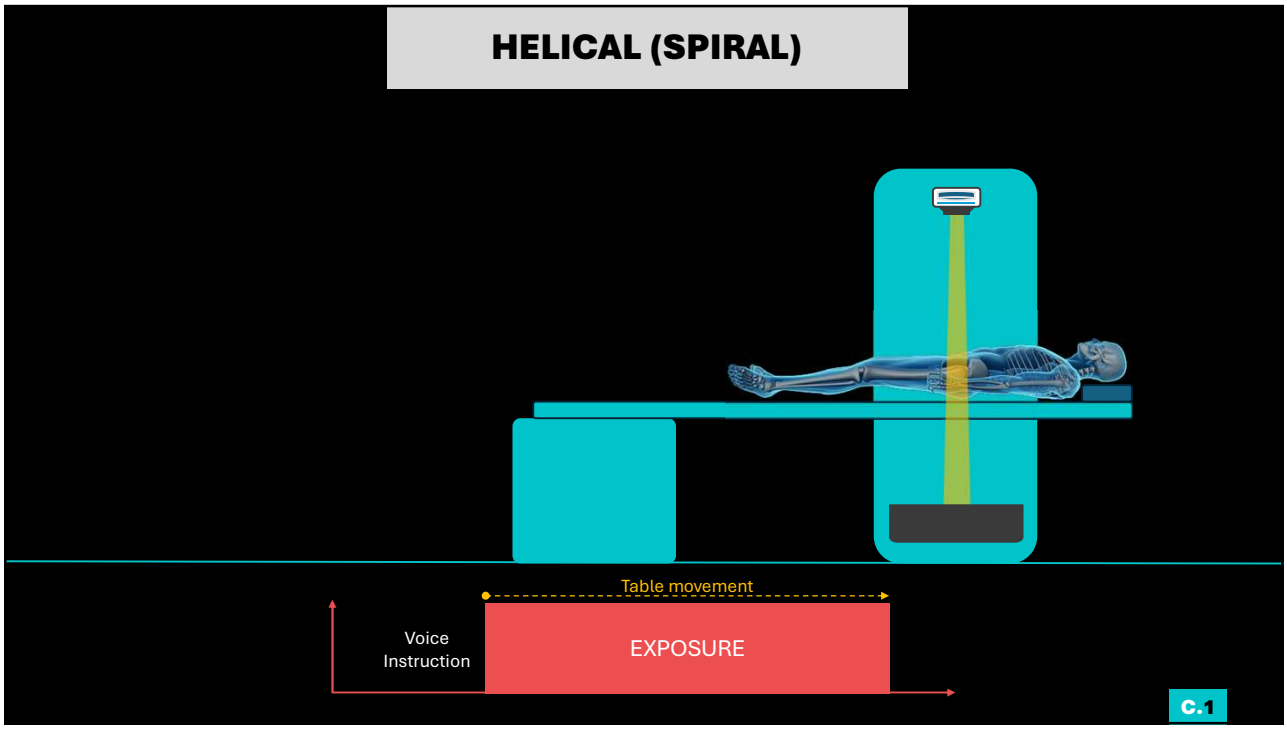
95


HELICAL (SPIRAL)
Voice
Instruction
C.1

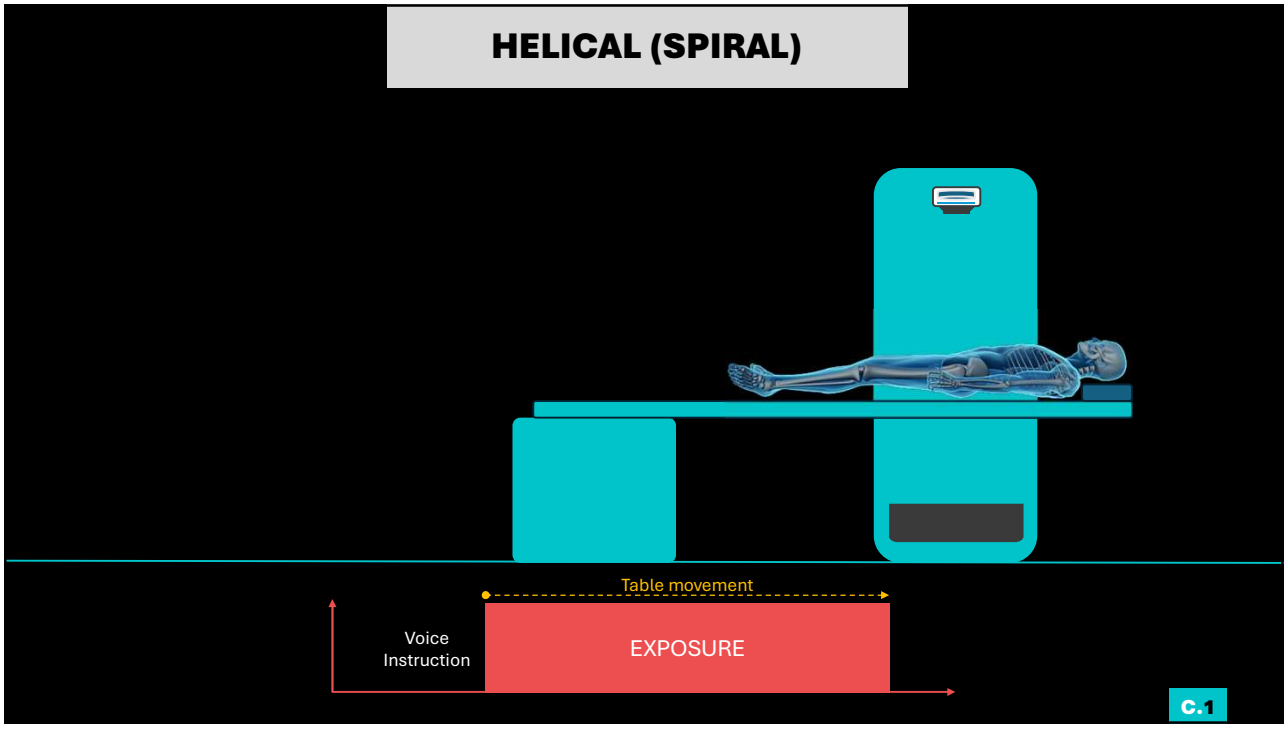
96


HELICAL (SPIRAL)
Table movement
Voice
Instruction
EXPOSURE
C.1

97


HELICAL (SPIRAL)
Table movement
Voice Instruction
EXPOSURE
C.1

98


HELICAL (SPIRAL)
Table movement
Voice Instruction
EXPOSURE
C.1

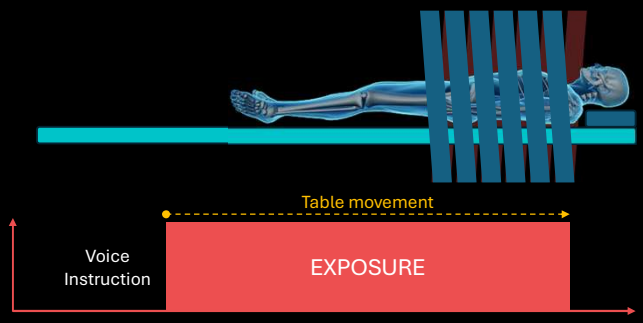
99

HELICAL (SPIRAL)

How it Works: The x-ray tube and detectors rotate continuously while the patient table moves through the gantry at a constant speed. This creates a spiral or helical path of data acquisition.

Pros: Gold standard of spatial resolution.

Cons: very slow, limited reformatting capability



C.1

100

SCANOGRAM (SCOUT OR LOCALIZER)

AXIAL (STEP & SHOOT)

The scan is performed sequentially one acquisition (exposure) at a time. The beam is turned on and off with table movement between exposures.

HELICAL (SPIRAL)

The scan is performed as one continuous exposure. The tube/detector constantly rotates and expose the patient while the table is constantly moves into the gantry

VOLUME

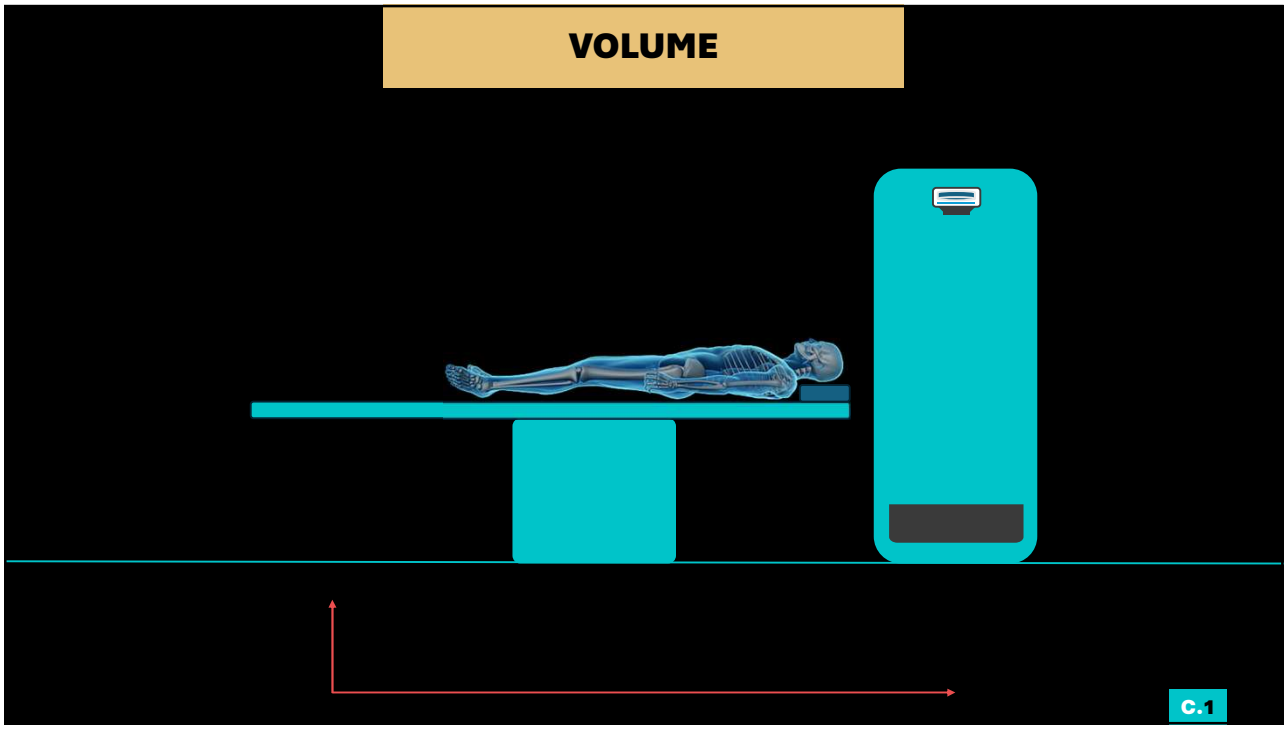
One shot exposure of an area of the patient (no table movement). The maximum possible size of the area is limited to the width of the detector in the Z-axis

DYNAMIC (CINE)

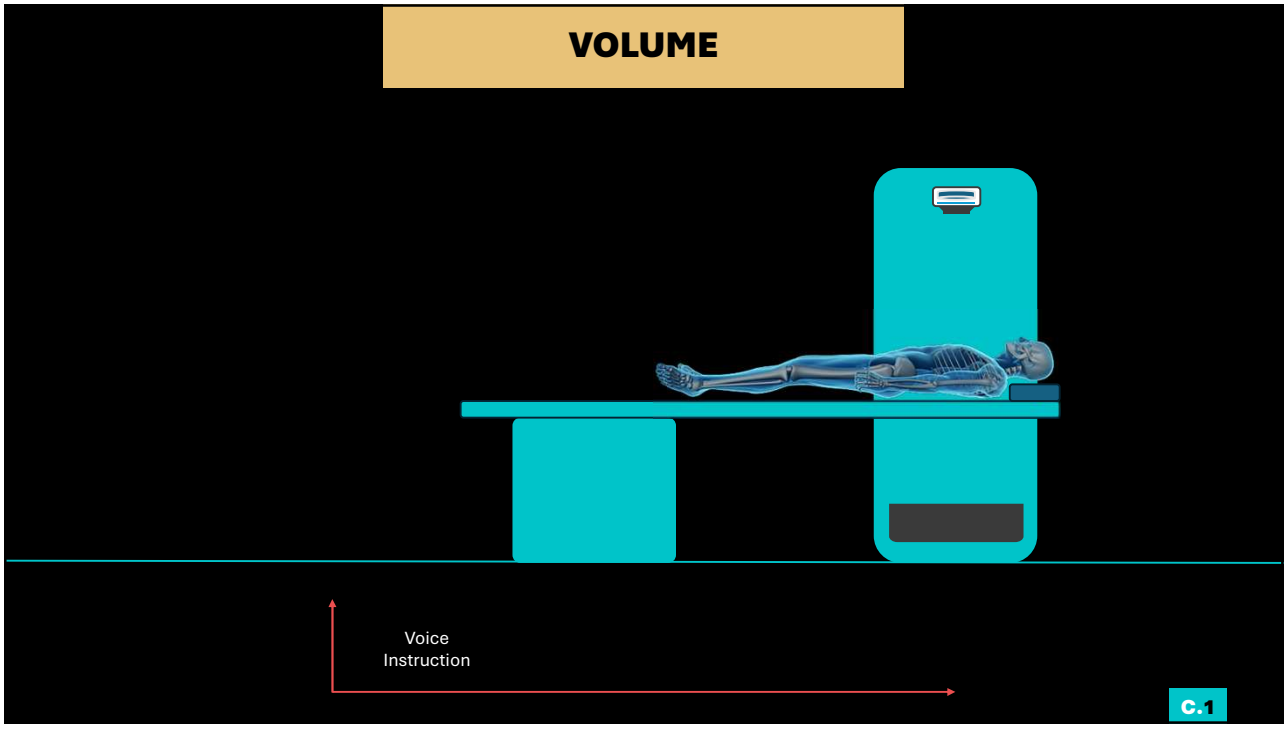
A continuous exposure or multiple exposures of an area of the patient (no table movement). Used for evaluation physiological evaluations.

C.1

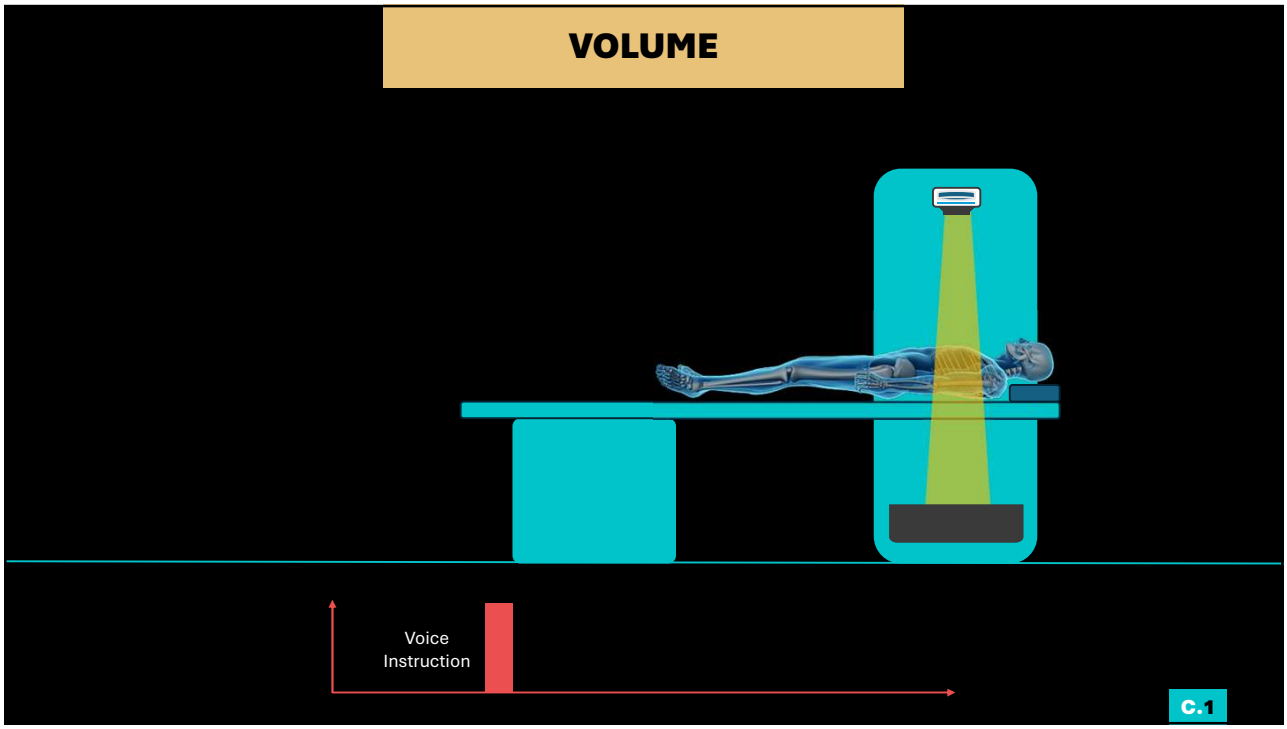
101



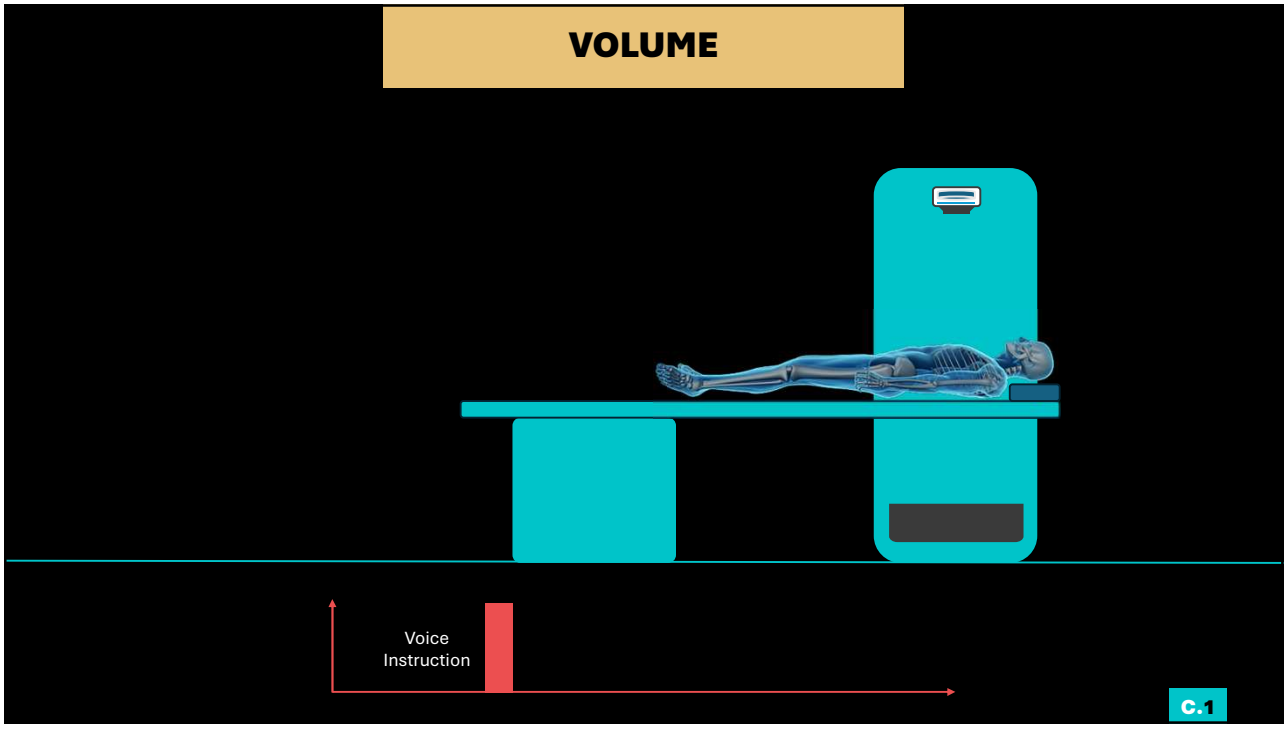
102



103



104



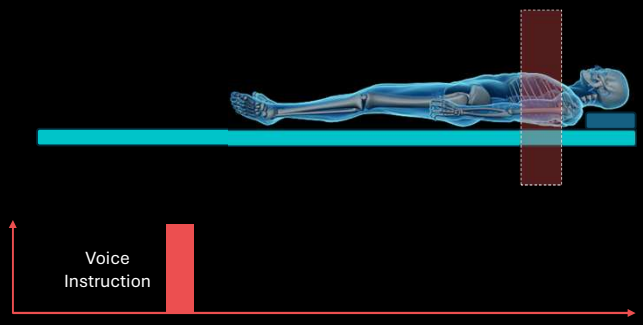
105

VOLUME

How it Works: Utilizing a large area detector and wide beam-collimation, a single large axial acquisition is completed in one rotation around the patient without table movement.

Pros: Acquires a large volume of data quickly, low radiation dose

Cons: limited coverage, may have lower spatial resolution compared to axial and helical scans, large area detector require deep gantry designs.



C.1

106

SCANOGRAM (SCOUT OR LOCALIZER)

AXIAL (STEP & SHOOT)

The scan is performed sequentially one acquisition (exposure) at a time. The beam is turned on and off with table movement between exposures.

HELICAL (SPIRAL)

The scan is performed as one continuous exposure. The tube/detector constantly rotates and expose the patient while the table is constantly moves into the gantry

VOLUME

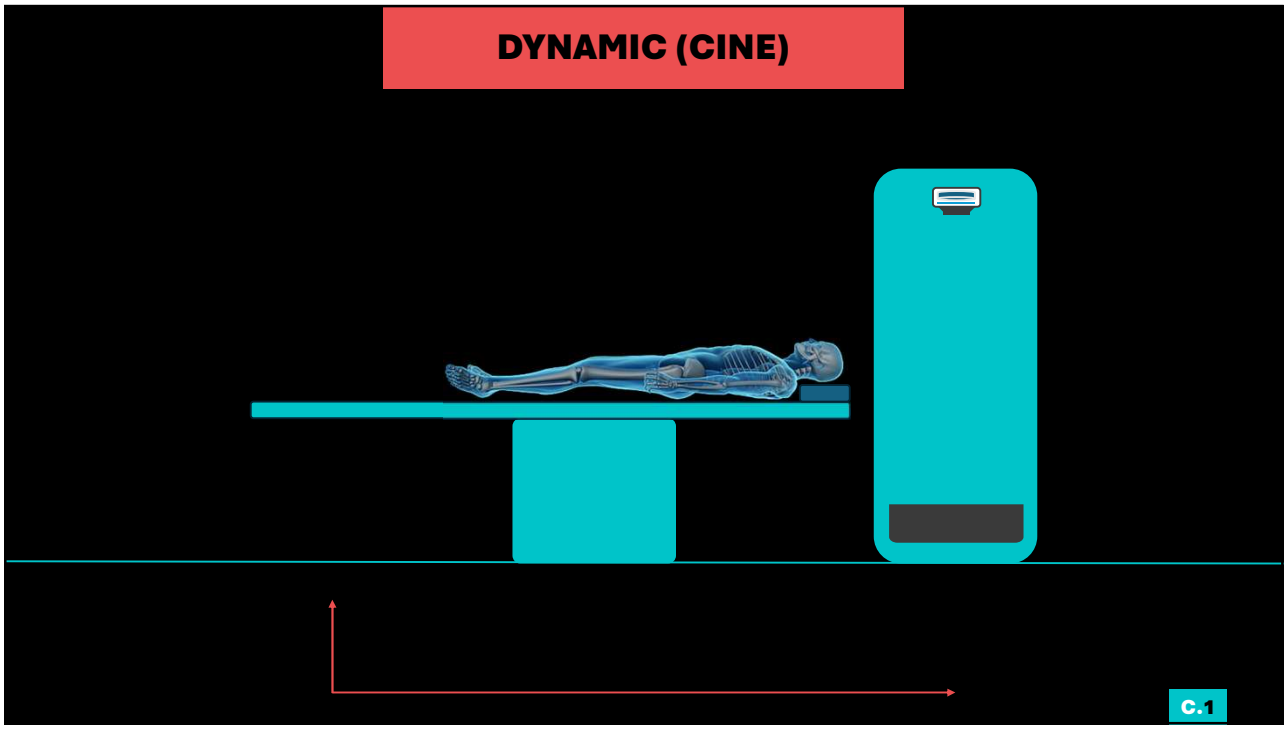
One shot exposure of an area of the patient (no table movement). The maximum possible size of the area is limited to the width of the detector in the Z-axis

DYNAMIC (CINE)

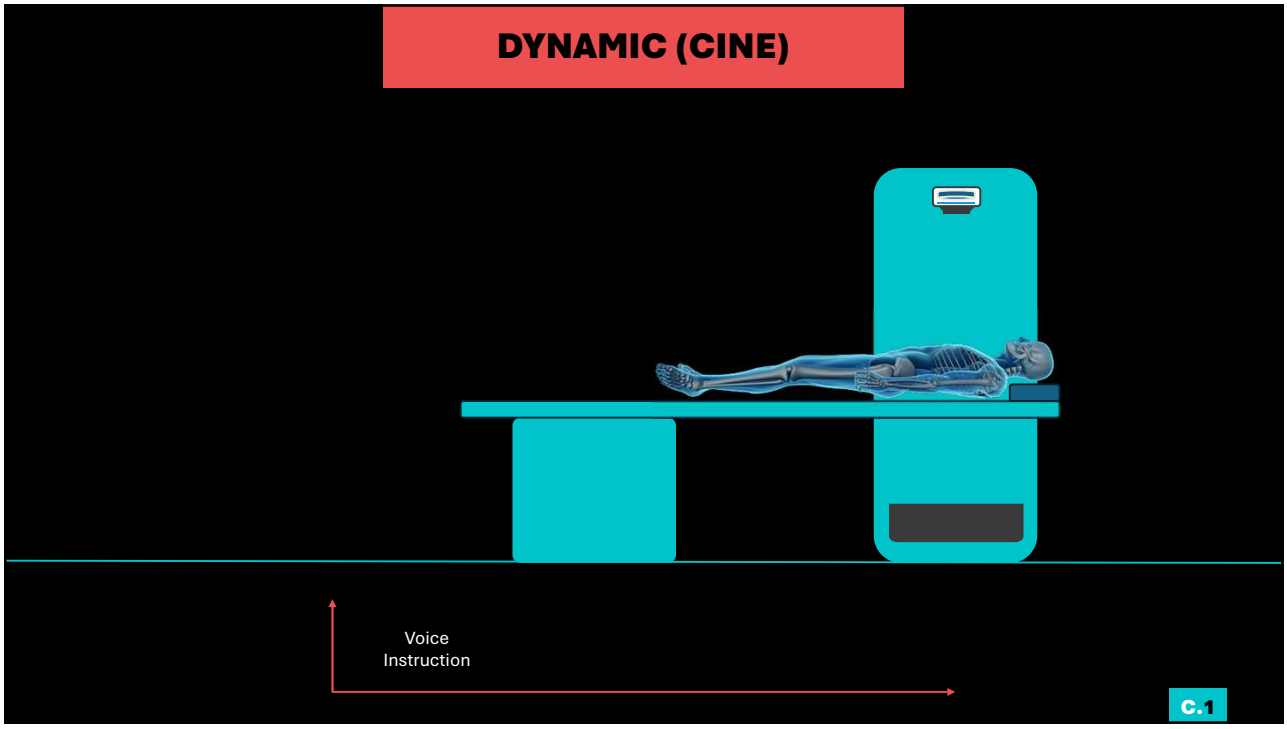
A continuous exposure or multiple exposures of an area of the patient (no table movement). Used for evaluation physiological evaluations.

C.1

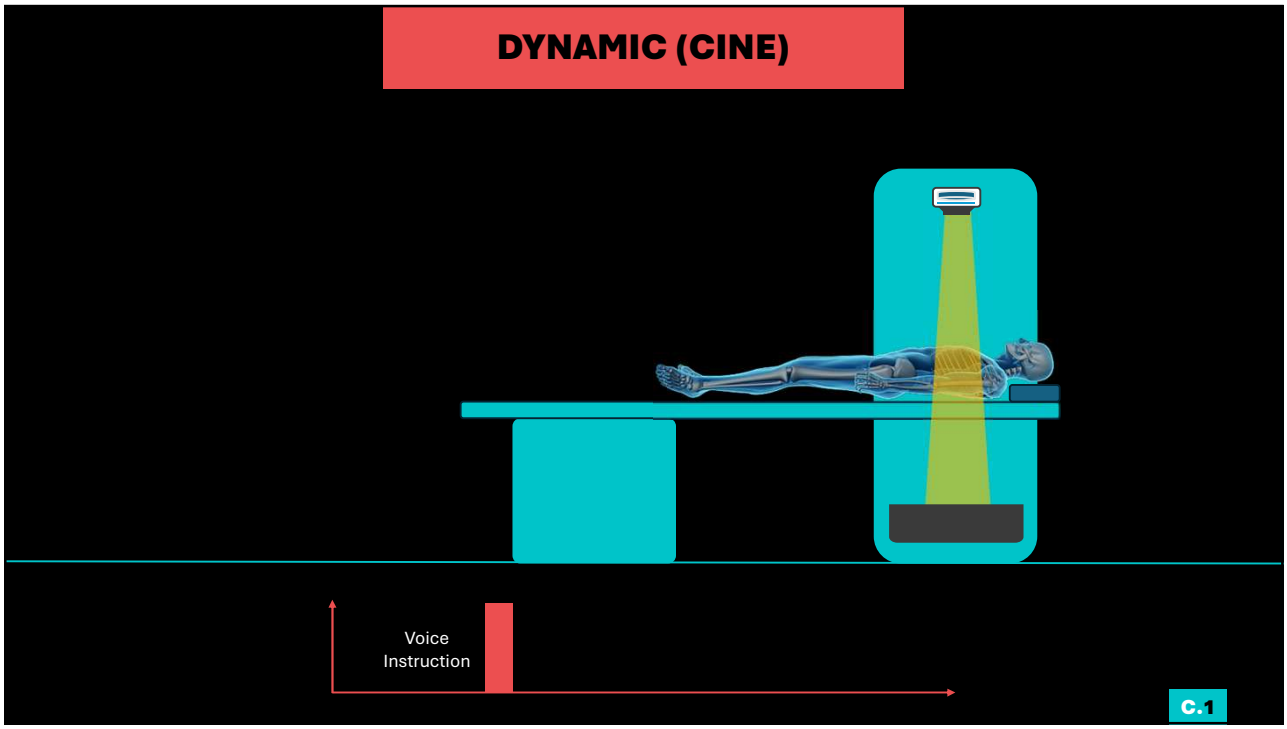
107



108



109


DYNAMIC (CINE)
Voice
Instruction
C.1

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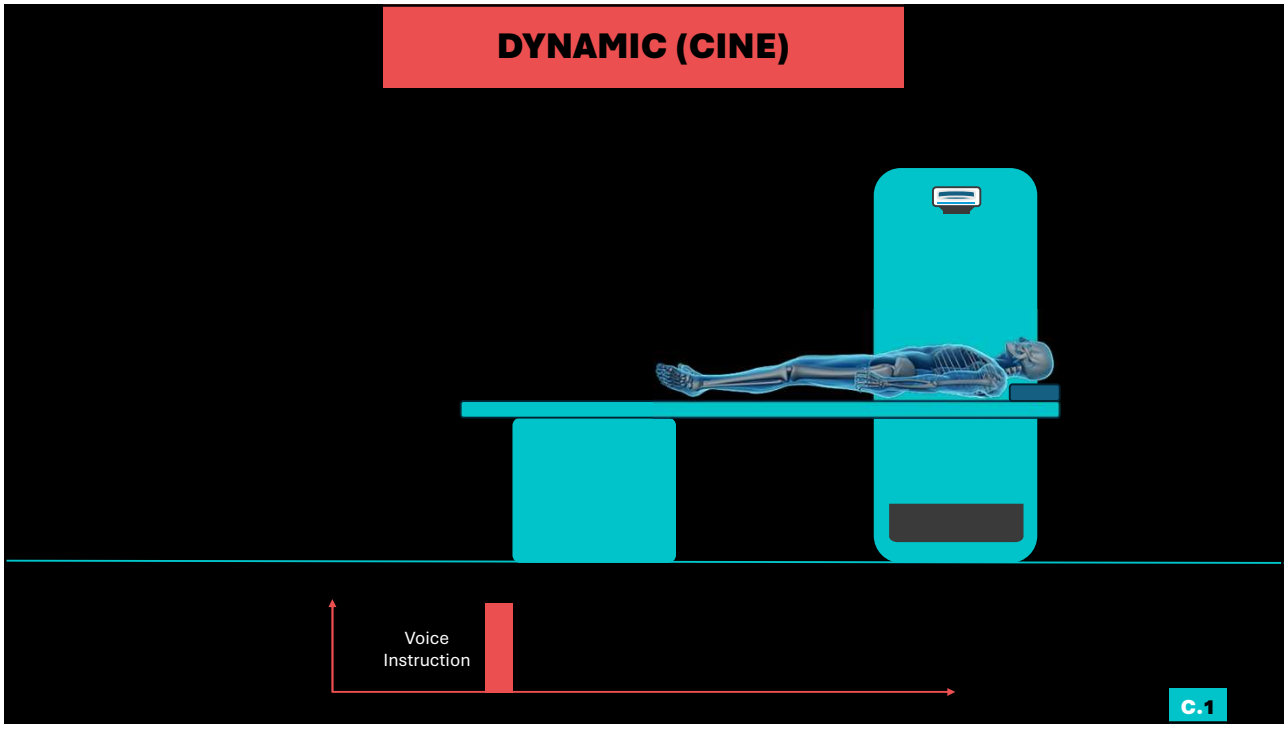
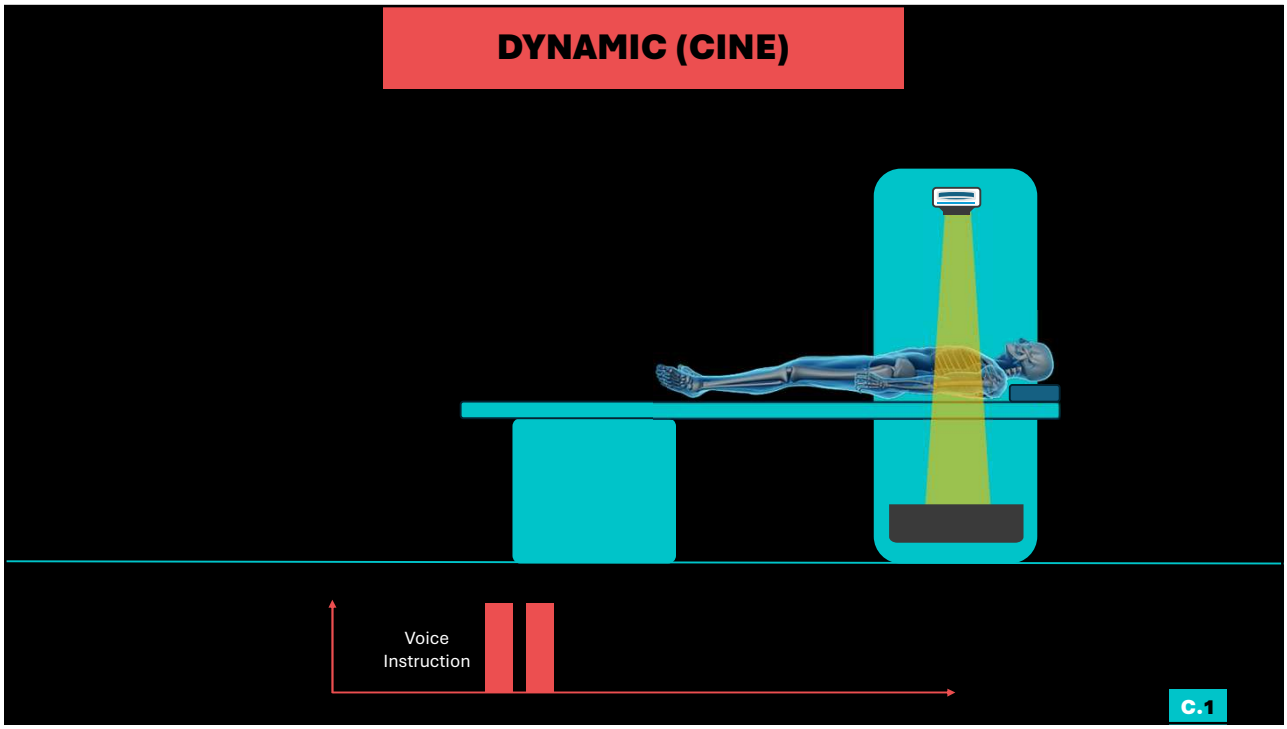
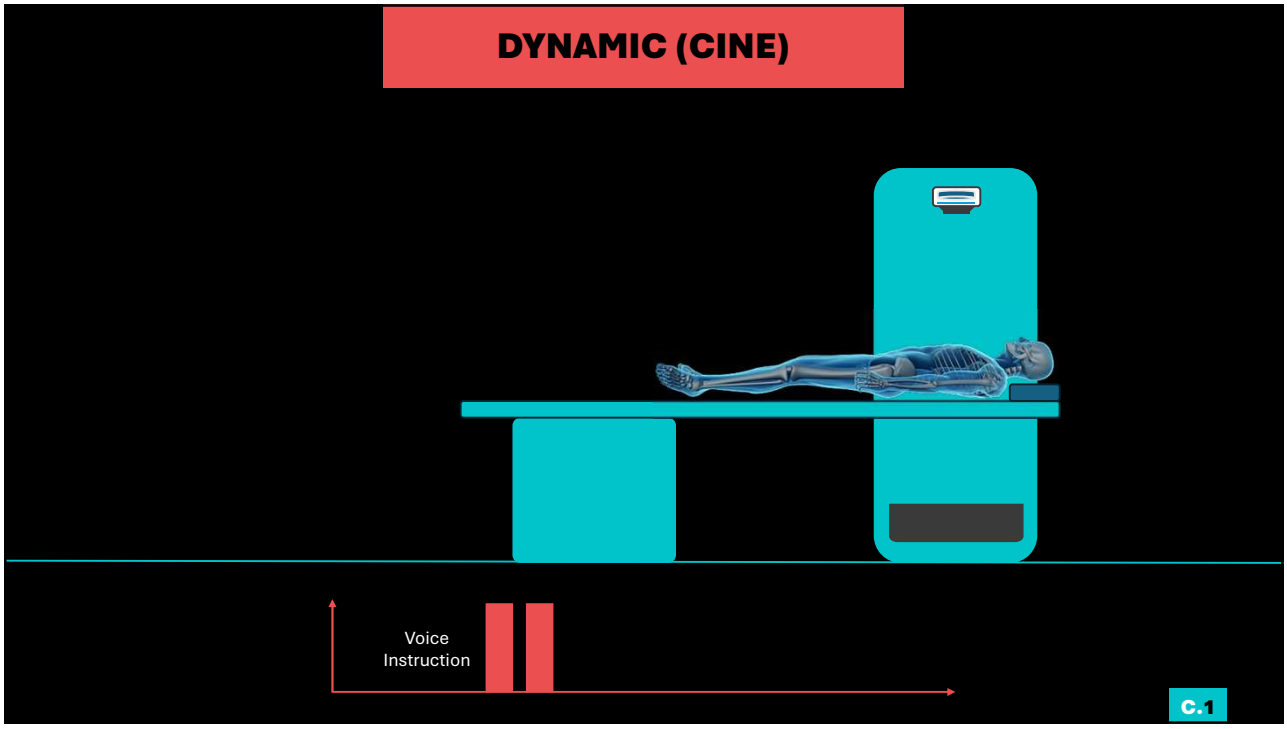

DYNAMIC (CINE)
Voice
Instruction
C.1

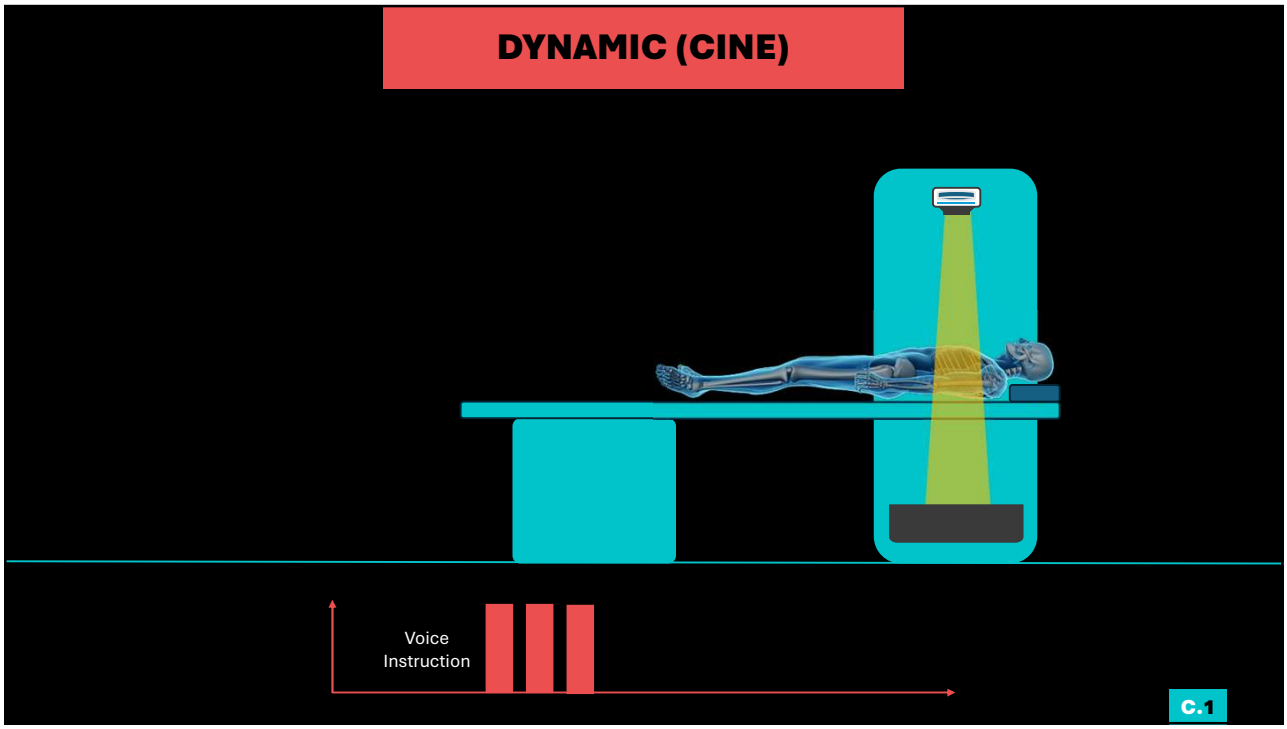
111


DYNAMIC (CINE)
Voice
Instruction
C.1

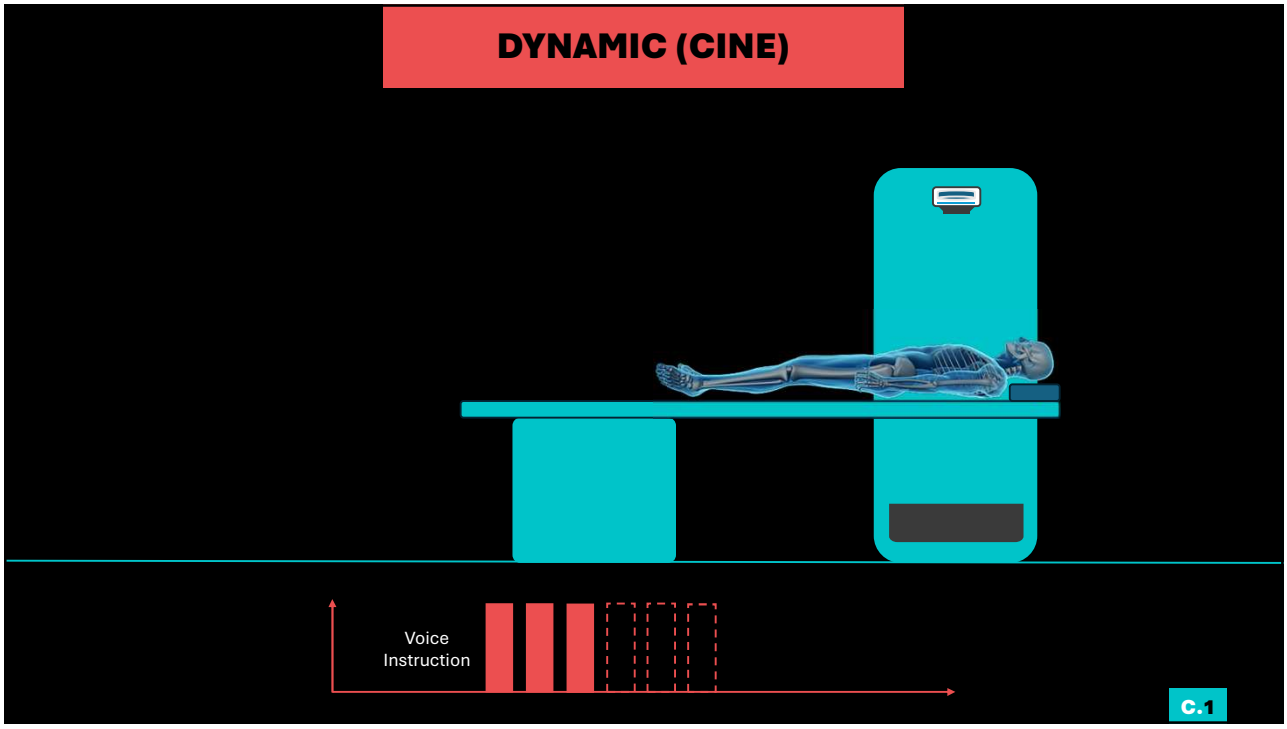
112


DYNAMIC (CINE)
Voice
Instruction
C.1

113


DYNAMIC (CINE)
Voice
Instruction
C.1

114


DYNAMIC (CINE)
Voice
Instruction
C.1

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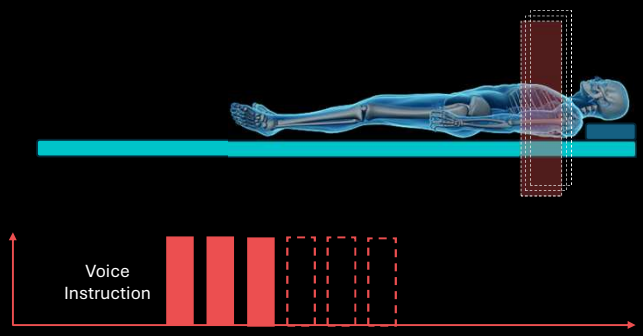
DYNAMIC (CINE)

How it Works: Acquires a series of images rapidly over time to visualize moving structures, such as the heart or blood vessels.

Pros: functional information, real-time visualization of dynamic processes.

Cons: very high dose, very large data storage requirements.



C.1

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SCANOGRAM (SCOUT OR LOCALIZER)

AXIAL (STEP & SHOOT)

The scan is performed sequentially one acquisition (exposure) at a time. The beam is turned on and off with table movement between exposures.

HELICAL (SPIRAL)

The scan is performed as one continuous exposure. The tube/detector constantly rotates and expose the patient while the table is constantly moves into the gantry

VOLUME

One shot exposure of an area of the patient (no table movement). The maximum possible size of the area is limited to the width of the detector in the Z-axis

DYNAMIC (CINE)

A continuous exposure or multiple exposures of an area of the patient (no table movement). Used for evaluation physiological evaluations.

C.1

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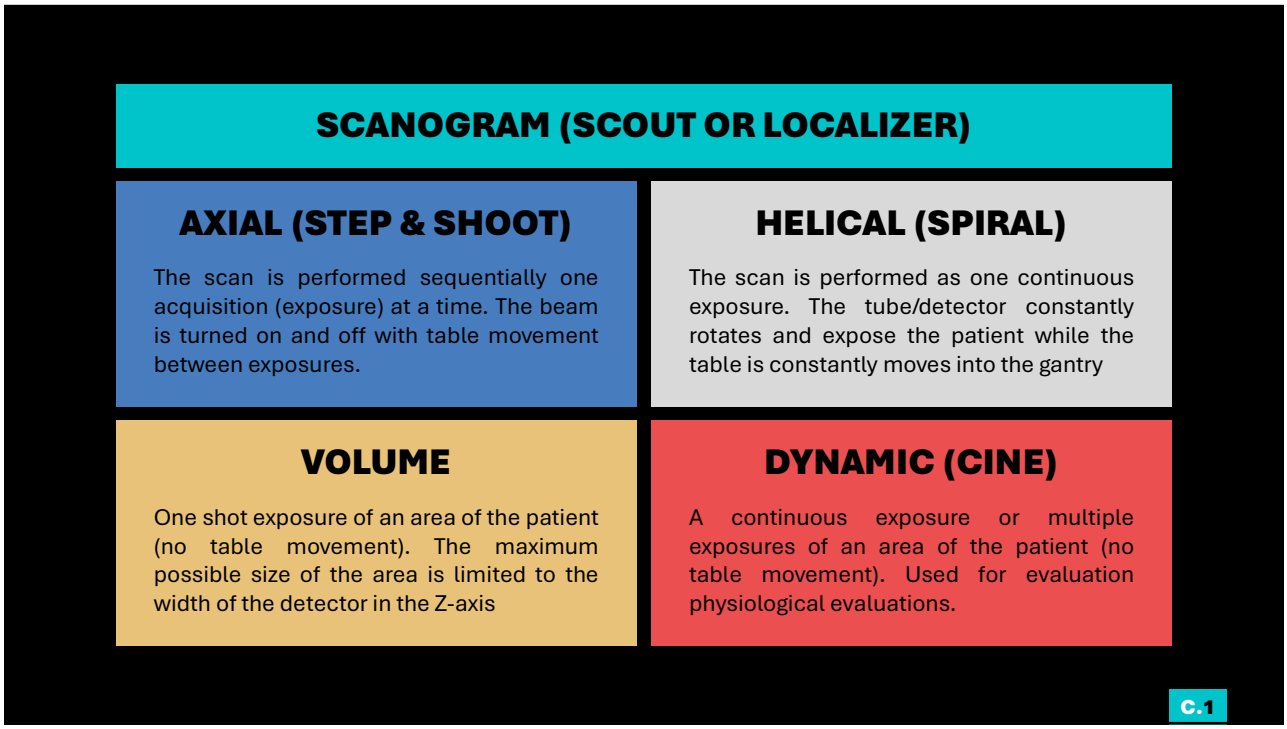
SCANOGRAM (SCOUT OR LOCALIZER)
AXIAL (STEP & SHOOT)
The scan is performed sequentially one acquisition (exposure) at a time. The beam is turned on and off with table movement between exposures.
HELICAL (SPIRAL)
The scan is performed as one continuous exposure. The tube/detector constantly rotates and expose the patient while the table is constantly moves into the gantry
VOLUME
One shot exposure of an area of the patient (no table movement). The maximum possible size of the area is limited to the width of the detector in the Z-axis
DYNAMIC (CINE)
A continuous exposure or multiple exposures of an area of the patient (no table movement). Used for evaluation physiological evaluations.
C.1

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CHAPTER
ONE
OVERVIEW
KEY PRINCIPLES
TYPES & COMPONENTS
ACQUISITION MODES
IMAGE FORMATION

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CHAPTER
ONE
OVERVIEW
KEY PRINCIPLES
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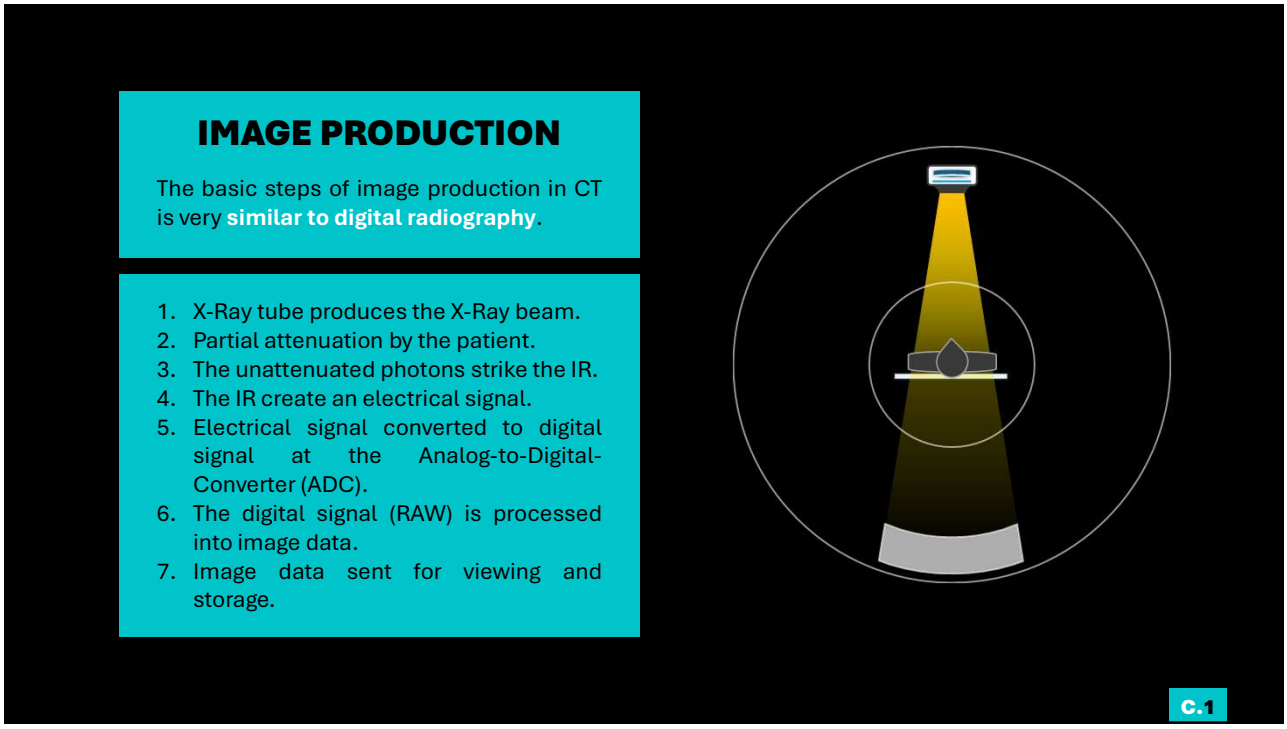
IMAGE PRODUCTION
The basic steps of image production in CT is very similar to digital radiography.
1. X-Ray tube produces the X-Ray beam.
2. Partial attenuation by the patient.
3. The unattenuated photons strike the IR.
4. The IR create an electrical signal.
5. Electrical signal converted to digital signal at the Analog-to-Digital-Converter (ADC).
6. The digital signal (RAW) is processed into image data.
7. Image data sent for viewing and storage.
C.1

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IMAGE PRODUCTION

The basic steps of image production in CT is very **similar to digital radiography**.

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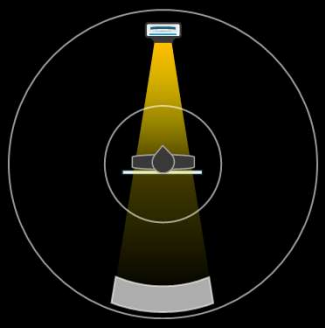
7. Image data sent for viewing and storage.



This step is different in CT compared to Digital radiography.

In CT hundreds of projections must be combined into a volume of data and then organized into slices

C.1

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DIGITALLY RECONSTRUCTED

AXIAL SLICE

AN IMAGE OF THE OBJECT

C.1

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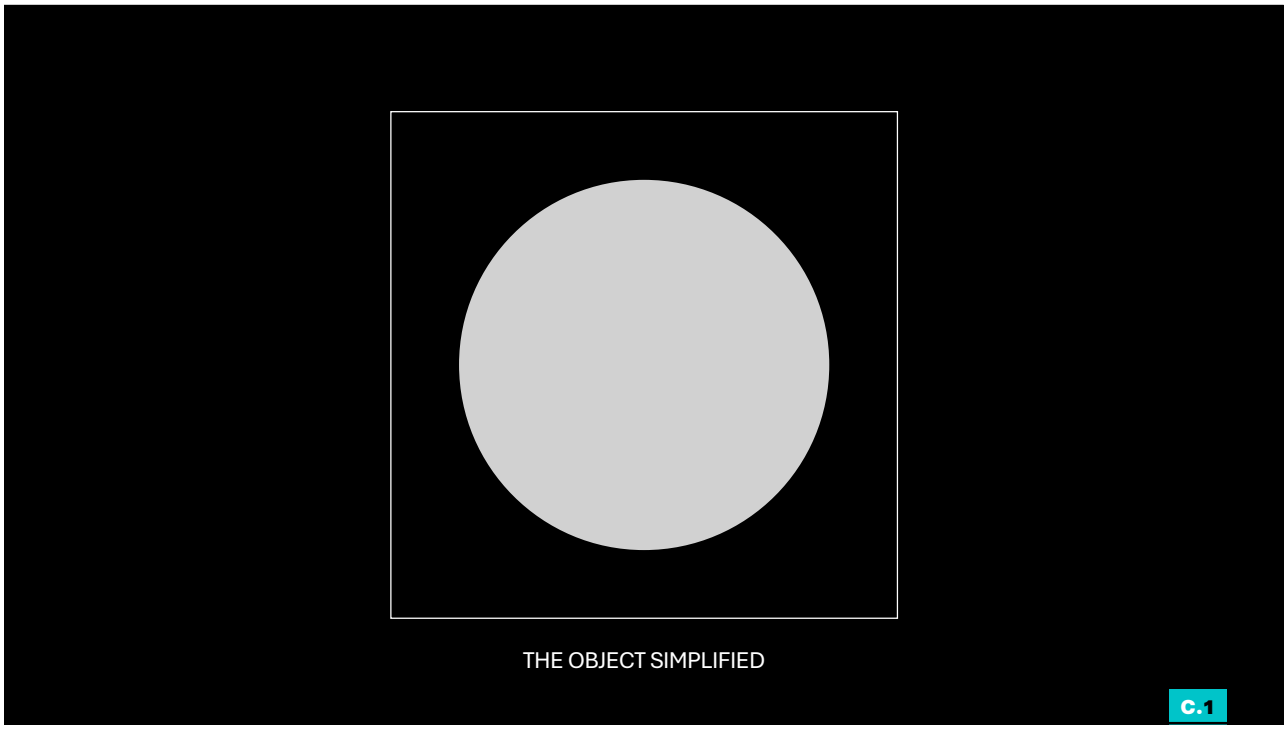
THE OBJECT SIMPLIFIED
C.1

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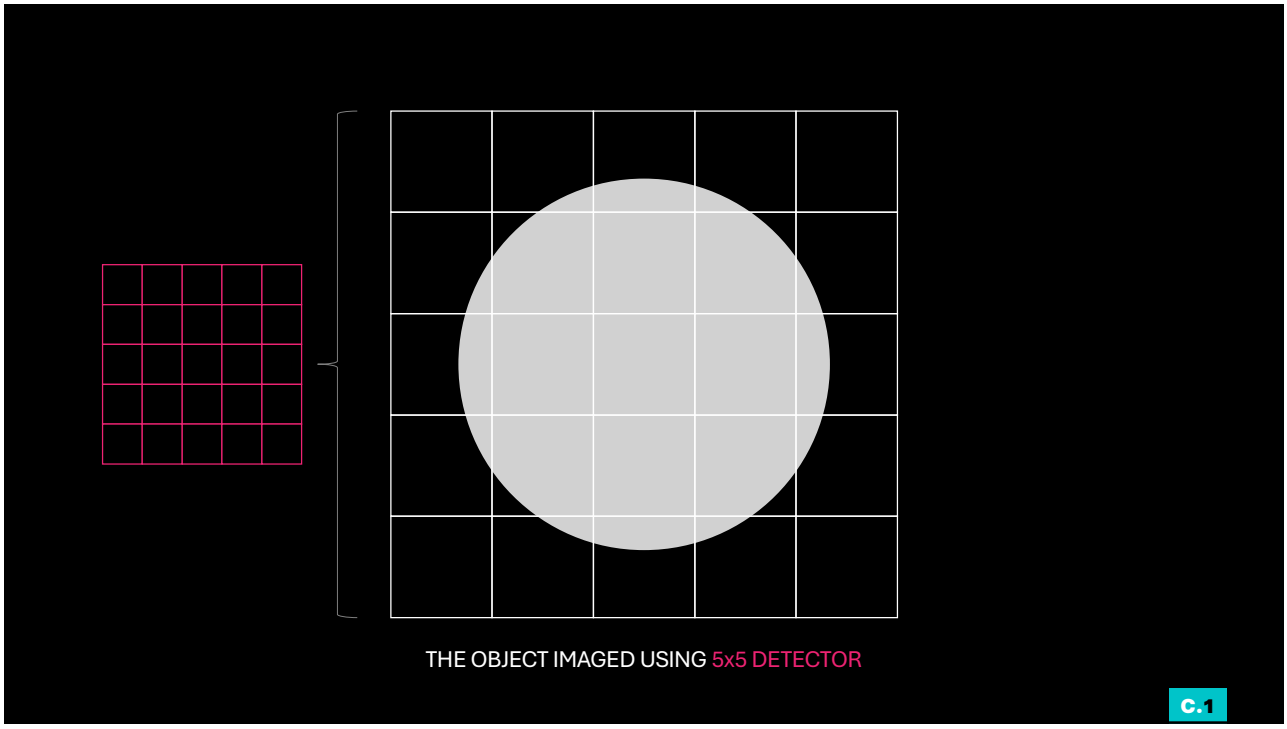
THE OBJECT IMAGED USING 5x5 DETECTOR
C.1

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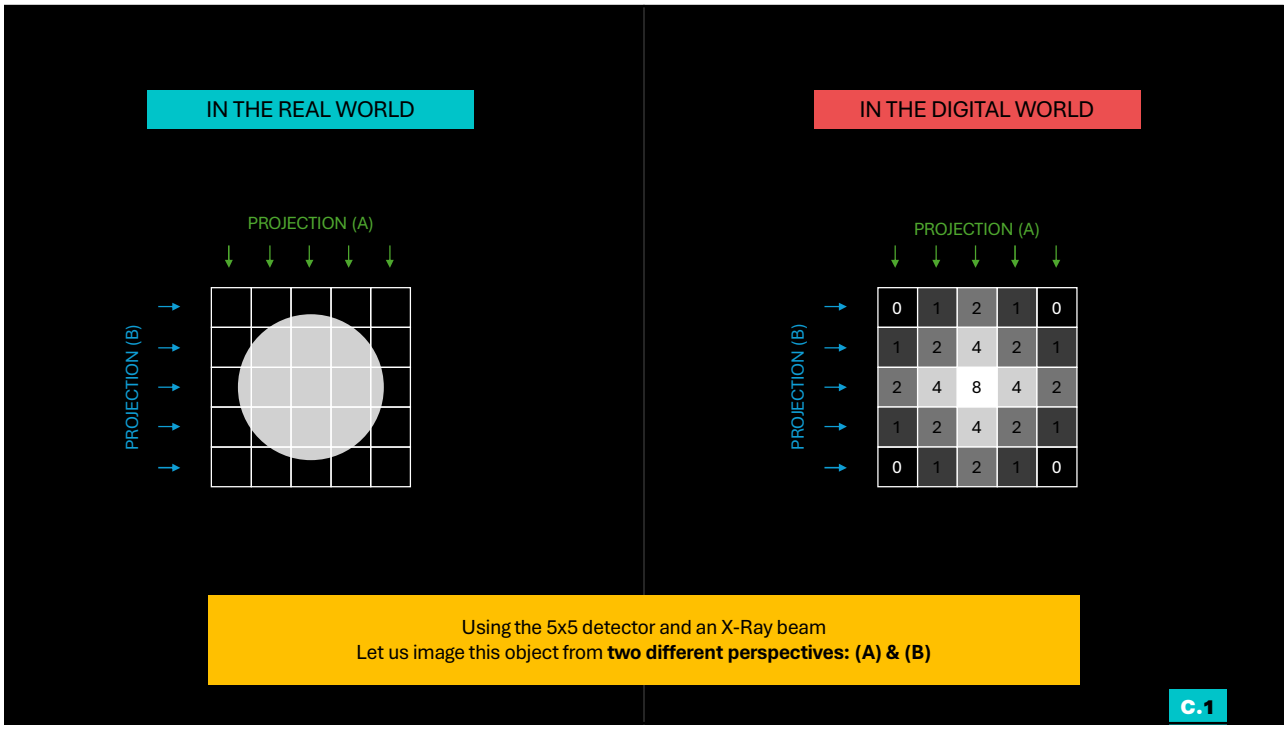
IN THE REAL WORLD
IN THE DIGITAL WORLD
PROJECTION (A)
PROJECTION (B)
PROJECTION (A)
PROJECTION (B)
0 1 2 1 0
1 2 4 2 1
2 4 8 4 2
1 2 4 2 1
0 1 2 1 0
Using the 5x5 detector and an X-Ray beam
Let us image this object from **two different perspectives: (A) & (B)**
C.1

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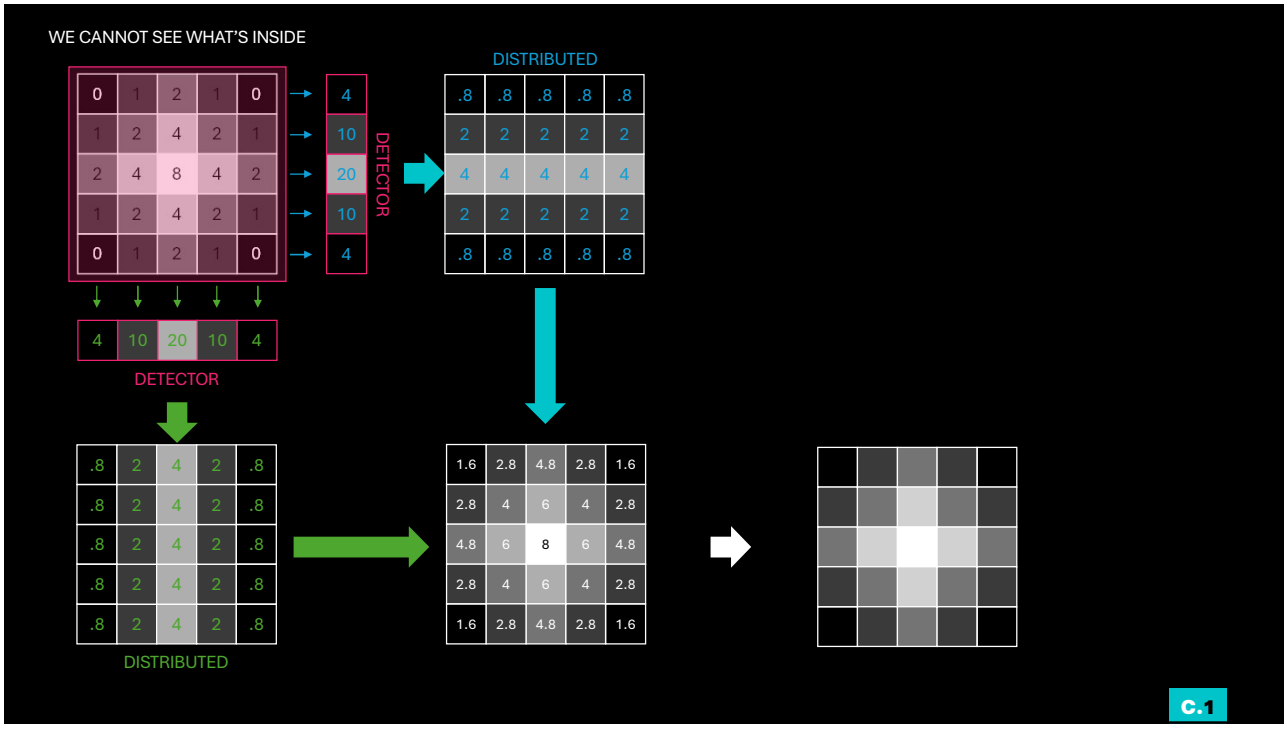
WE CANNOT SEE WHAT'S INSIDE
DISTRIBUTED
DETECTOR
4 10 20 10 4
DETECTOR
DISTRIBUTED
C.1

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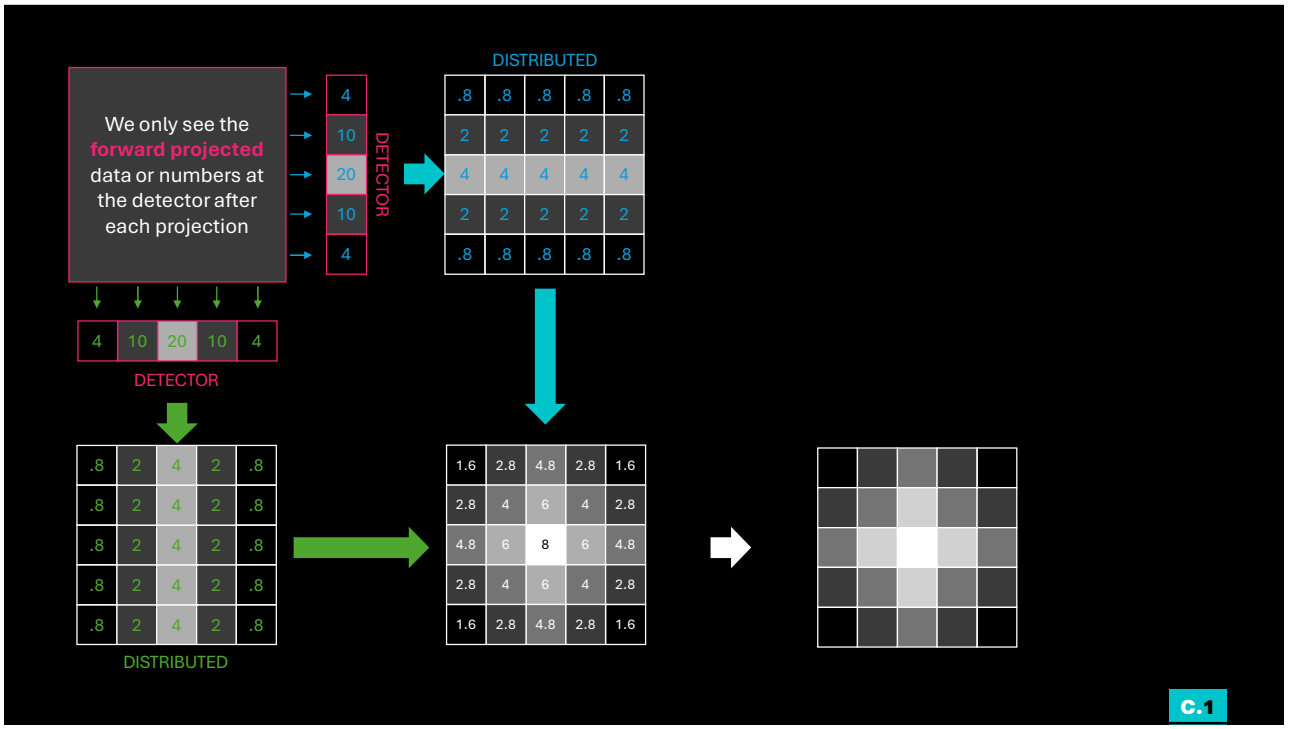
We only see the forward projected data or numbers at the detector after each projection
4
10
20
10
4
DETECTOR
DISTRIBUTED
.8 .8 .8 .8 .8
2 2 2 2 2
4 4 4 4 4
2 2 2 2 2
.8 .8 .8 .8 .8
4 10 20 10 4
DETECTOR
.8 2 4 2 .8
.8 2 4 2 .8
.8 2 4 2 .8
.8 2 4 2 .8
.8 2 4 2 .8
DISTRIBUTED
1.6 2.8 4.8 2.8 1.6
2.8 4 6 4 2.8
4.8 6 8 6 4.8
2.8 4 6 4 2.8
1.6 2.8 4.8 2.8 1.6
C.1

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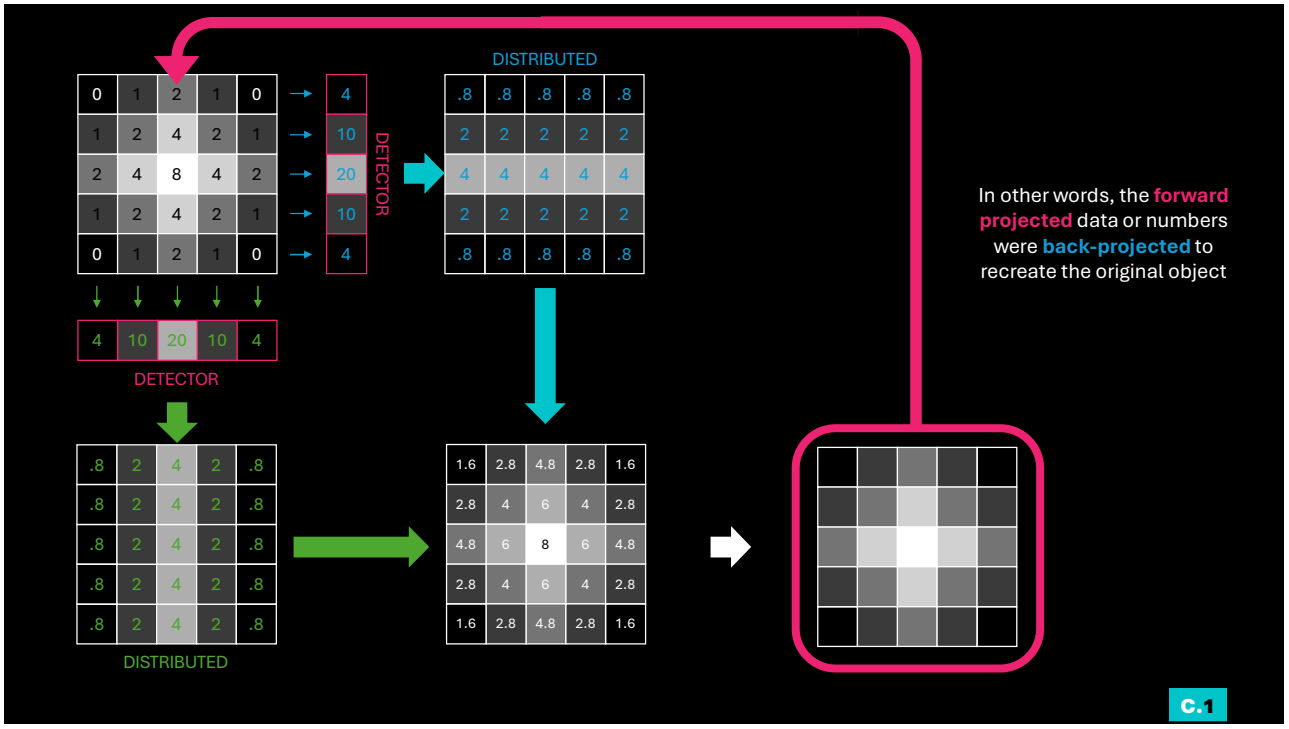
0 1 2 1 0
1 2 4 2 1
2 4 8 4 2
1 2 4 2 1
0 1 2 1 0
4
10
20
10
4
DETECTOR
DISTRIBUTED
.8 .8 .8 .8 .8
2 2 2 2 2
4 4 4 4 4
2 2 2 2 2
.8 .8 .8 .8 .8
4 10 20 10 4
DETECTOR
.8 2 4 2 .8
.8 2 4 2 .8
.8 2 4 2 .8
.8 2 4 2 .8
.8 2 4 2 .8
DISTRIBUTED
1.6 2.8 4.8 2.8 1.6
2.8 4 6 4 2.8
4.8 6 8 6 4.8
2.8 4 6 4 2.8
1.6 2.8 4.8 2.8 1.6
In other words, the forward projected data or numbers were back-projected to recreate the original object
C.1

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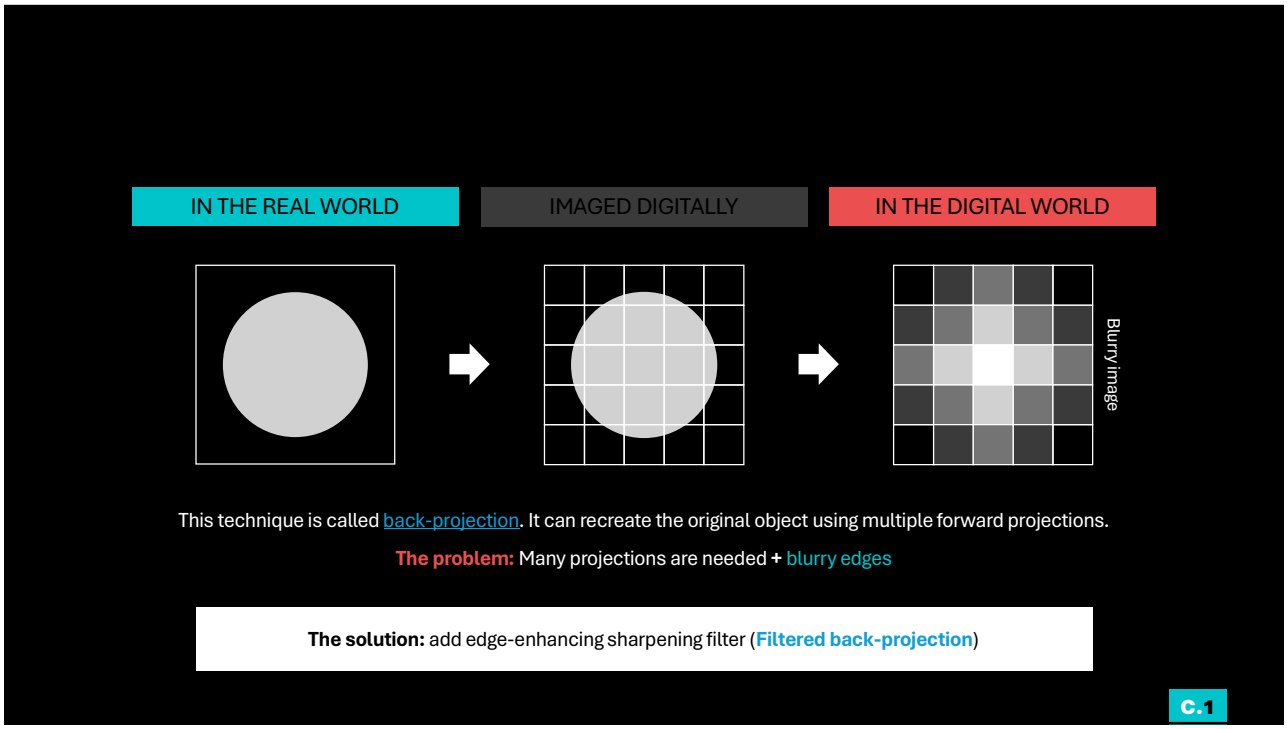
IN THE REAL WORLD
IMAGED DIGITALLY
IN THE DIGITAL WORLD
Blurry image
This technique is called back-projection. It can recreate the original object using multiple forward projections.
The problem: Many projections are needed + blurry edges
The solution: add edge-enhancing sharpening filter (Filtered back-projection)
C.1

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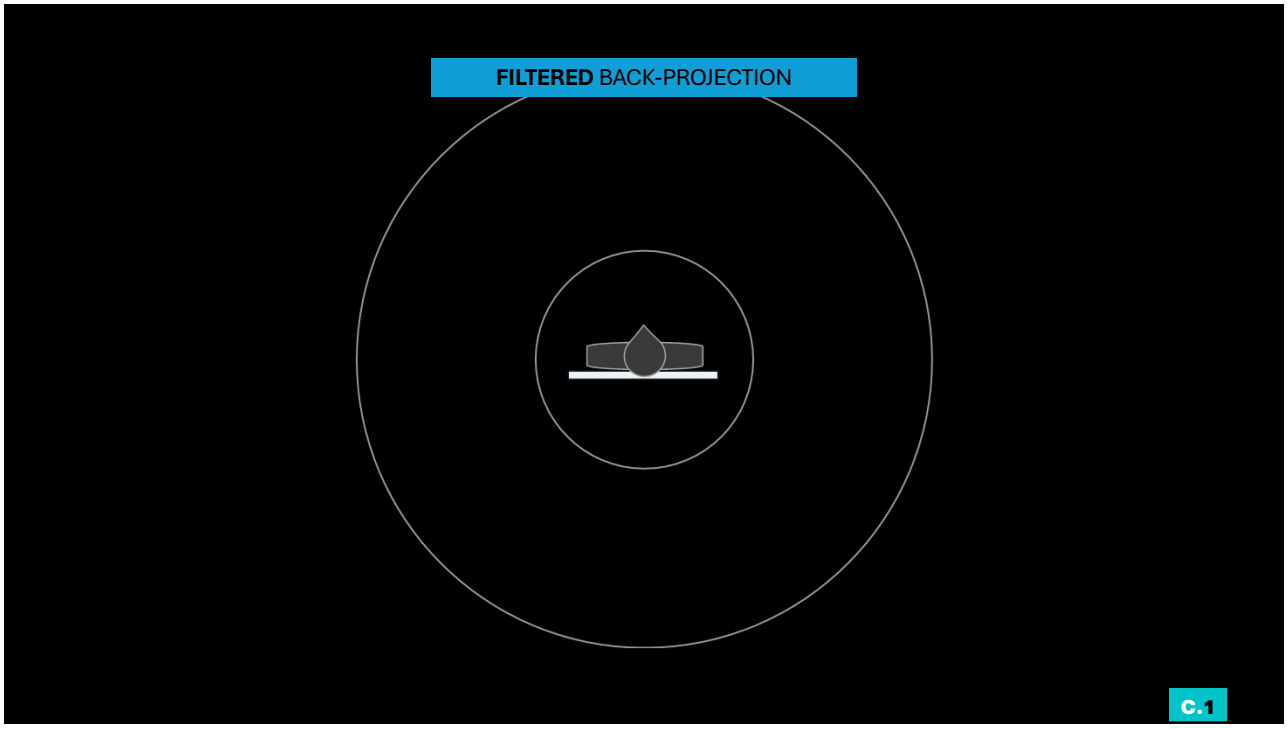
FILTERED BACK-PROJECTION
C.1

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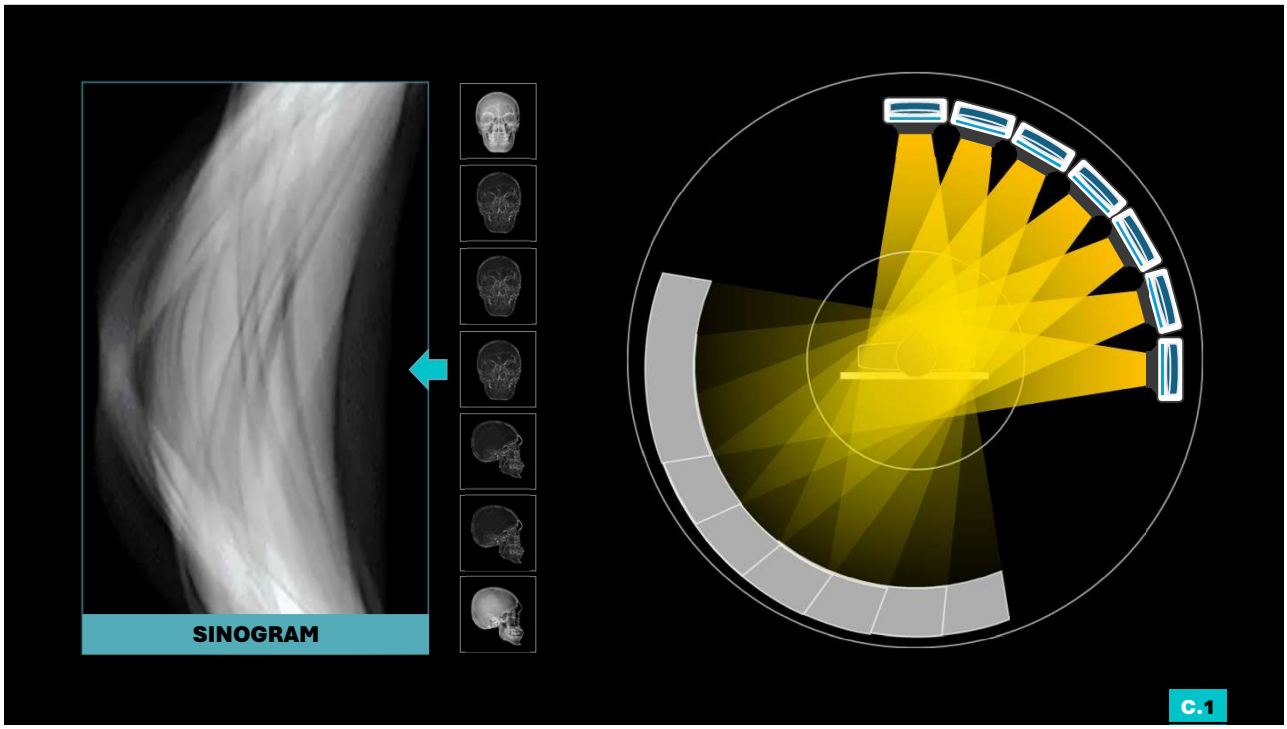
SINOGRAM
C.1

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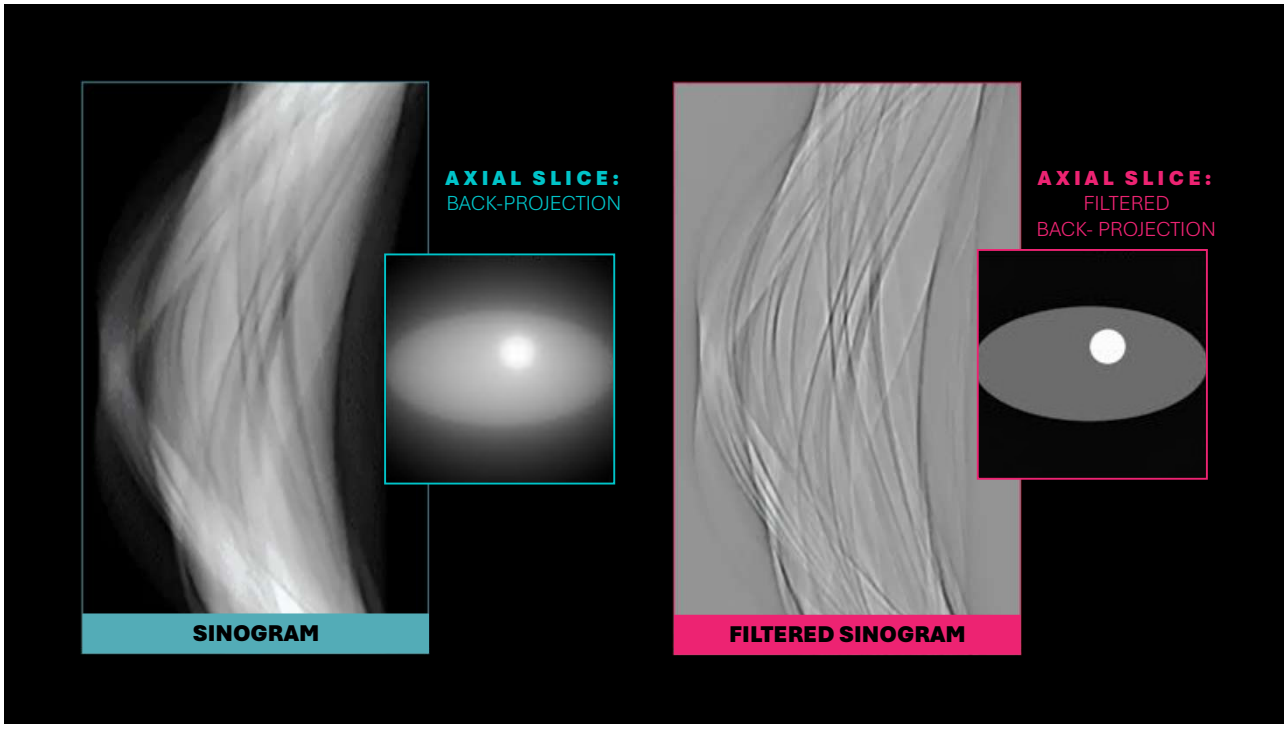
AXIAL SLICE:
BACK-PROJECTION
AXIAL SLICE:
FILTERED
BACK- PROJECTION
SINOGRAM
FILTERED SINOGRAM

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FILTERED BACK-PROJECTION

How it Works:

1. **Projection Data:** FBP starts with the projection data acquired by the detectors, which represents the attenuation of the x-ray beam as it passes through the patient from different angles.
2. **Back Projection:** The algorithm "smears" or "back projects" this projection data back onto the image grid. Imagine each projection as a blurred shadow of the object.
3. **Filtering:** To correct for the blurring introduced by back projection, a filter is applied in the frequency domain. This filter is designed to remove the "star-like" artifacts that would otherwise appear in the image.

PROS

- Fast and computationally efficient
- well-established (industry standard)

CONS

- Susceptible to noise and artifacts
- FBP does not explicitly account for the physics of x-ray interactions, which can lead to inaccuracies in the reconstructed image.

C.1

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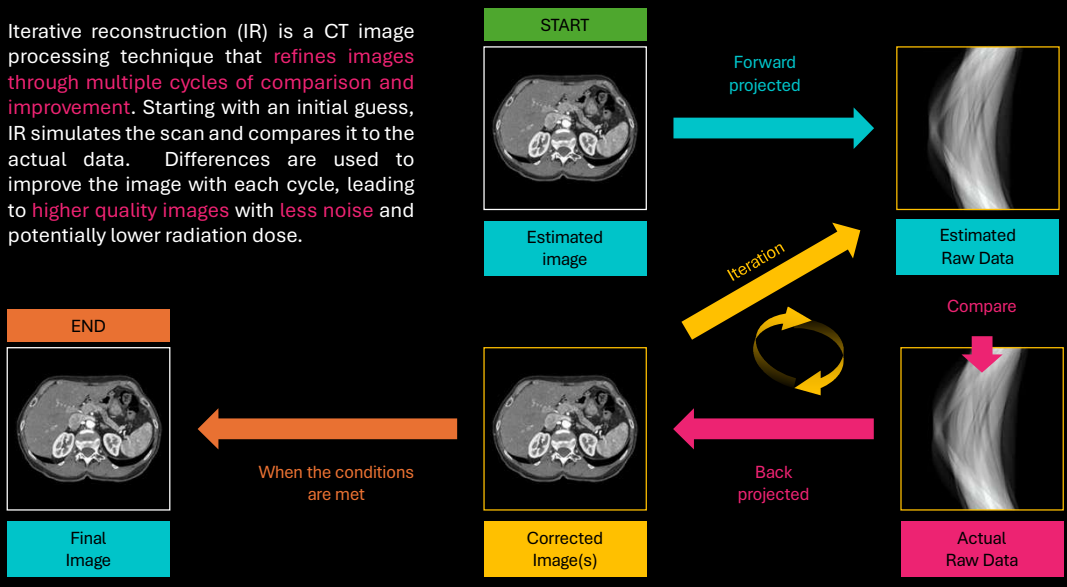
ITERATIVE RECONSTRUCTION

Iterative reconstruction (IR) is a CT image processing technique that refines images through multiple cycles of comparison and improvement. Starting with an initial guess, IR simulates the scan and compares it to the actual data. Differences are used to improve the image with each cycle, leading to higher quality images with less noise and potentially lower radiation dose.



C.1

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ITERATIVE RECONSTRUCTION

How it Works:

1. **Initial Image Estimate:** IR starts with an initial estimate of the image (FBP).
2. **Forward Projection:** The algorithm then "projects" this estimated image forward to simulate what the detector readings would be.
3. **Comparison:** These simulated projections are compared to the actual measured projections.
4. **Image Update:** Based on the difference between the simulated and measured projections, the algorithm updates the image estimate.
5. **Iteration:** This process is repeated iteratively, with each iteration refining the image estimate until it converges to a solution that is consistent with the measured data and the physics of the imaging process.

PROS

- Excellent noise reduction and Image quality
- Has potential to reduce the radiation dose
- Less susceptible to artifacts and can be used to reduce artifacts.

CONS

- Slow and computationally demanding
- Images may look “Plastic-y”

C.1

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CHAPTER
CONCLUDED
→ OVERVIEW
→ KEY PRINCIPLES
→ TYPES & COMPONENTS
→ ACQUISITION MODES
→ IMAGE FORMATION

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