

KARNATAKA RADIOLOGY EDUCATION PROGRAM

DIGITAL RADIOGRAPHY

Digital radiography is a form of radiography that uses x-ray–sensitive plates to directly capture data during the patient examination, immediately transferring it to a computer system without the use of an intermediate cassette.

Instead of using film to both detect and store image data, digital radiography uses digital detectors to produce a digital image, which is then stored separately on a digital medium. There are 4 steps in digital radiography: image generation, processing, archiving, and presentation.

computed radiography (CR): uses photostimulable phosphor (PSP) plates in cassettes

Direct digital radiography: images are registered directly in the detector without a need for an intermediate cassette direct conversion: x-rays are directly registered by the flat panel detector (FPDs)

Indirect conversion: x-rays are first converted to visible light by a scintillator and then registered by the detector indirect flat panel detector (FPDs)

Charge-coupled device (CCD) detector complementary metal-oxide-semiconductor (CMOS) detector.

COMPUTED RADIOGRAPHY

Components:

- 1. Standard X Ray unit
- 2. CR plate
- 3. Digitizer
- 4. Printer
- 5. PMT & AD converter



Computed radiography (CR) is the use of photostimulable phosphor as an image receptor. The image receptor is held in a similar casing (cassette) to that of the traditional film screen. Computed radiography harnesses the absorption of radiation, trapping electrons at energy levels via the process of photostimulable luminescence.

CR enables the transition of conventional radiography to digital radiography, by using existing x-ray equipments for conventional radiography .

Electron storage

The computed radiography plate has a thin layer of phosphor grains, known as a photostimulable phosphor. The plate is exposed to x-ray radiation exciting the phosphor, exciting the electrons to be trapped in the lattice until inevitably they are stimulated by the second round of illumination.

Analog to digital conversion

The computed radiography plate is exposed to a small, high-intensity laser (typically emitting 680nm red light) resulting in the return of previously trapped electrons to their respective valence bands, letting off violet light (approx. 400-450nm).

A photomultiplier tube (PMT) will interpret this violet light and convert it into an electric signal that, via an analog-to-digital converter (ADC), is digitized and mapped onto a pixel matrix.

Using a white light, the computed radiography plate can be 'reset', thus they can be reused repeatedly if carefully handled.

Digital radiography

Digital Radiography Sys based.

Digital Radiography

Computed radiography (CR) which is cassette

- **Direct Digital** adiography (DR) which is cassette-less Charge-coupled
- Direct Conversion

Digital radiography is based on capturing and storing the radiograph using discrete (digital) values 1 as opposed to conventional film radiography, which uses analog (continuous) values. It removes the requirement of dark room procedures.

Terminology

The term digital radiography is often used to address only direct digital radiography and therefore exclude computed radiography (CR). There is no universal term referring to the entirety of digital techniques in radiography, which would unambiguously encompass both computed radiography and direct digital radiography 2.

Technologies

computed radiography (CR): uses photostimulable phosphor (PSP) plates in cassettes

Direct digital radiography: images are registered directly in the detector without a need for an intermediate cassette direct conversion: x-rays are directly registered by the flat panel detector (FPDs)

indirect conversion: x-rays are first converted to visible light by a scintillator and then registered by the detector

indirect flat panel detector (FPDs)

charge-coupled device (CCD) detector

complementary metal-oxide-semiconductor (CMOS) detector

Flat panel detector (FPD) is the most common detector type used in direct digital radiography (DR). The x-rays are converted to electrical charges, either directly or indirectly (x-rays first converted to visible light, then to charges). The charges are then read out using a thin film transistor (TFT) array.

TFT active-matrix array is consisting of a transistor, charge collector electrode, and a storage capacitor with amorphous silicon substrate.

Types

Indirect flat panel detector, Construction of an indirect flat panel detector:

scintillator layer made of cesium iodide (CsI) photodiode made of amorphous silicon (a-Si) TFT readout array X-ray photons encounter a cesium iodide (CsI) scintillator and are converted to visible light. The needle-like CsI structure acts to minimize scatter at this step. The light then reaches a low-noise amorphous silicon (a-Si) photodiode array where it is converted into an electrical charge. Each photodiode represents a single pixel, and each produces an electrical charge that is read out digitally by the TFT array layer underneath before finally being sent to the

image processor .

A similar process of coupling a scintillator with a visible light detector can be implemented using charge-coupled device (CCD) or complementary metal–oxide–semiconductor (CMOS) detectors. These are not classified as flat panel detectors. Their implementation is limited due to restricted size of the detectors

Direct flat panel detector, Construction of a direct flat panel detector:

high voltage electrode photoconductor layer made of amorphous selenium (a-Se) TFT readout array

This technique employs a semiconductor material which produces electron-hole pairs in proportion to the incident x-ray intensity. The most commonly used semiconductor is amorphous selenium (a-Se)

COMPARISION BETWEEN COVENTIONAL X-RAY AND CR

CONVENTIONAL X-RAY	COMPUTED RADIOGRAPHY
 Older technology. 	> Advanced technology
 Cheaper technology. 	> Expensive technology.
 Post processing by using various chemicals. 	➤ Post processing by using signals.
 Intensitying screen is used. 	> Intensitying screen is not used.
 Manipulation of image is not possible once it is formed. 	 Manipulation of image is possible once it is formed.
 Trained manpower can also function it. 	 Skilled manpower is required.
➤ Film is used as IR.	➤ PSP plate is used as IR.
➤ Formed image cant be erased.	➤ Formed image can be erased and reused for next patient.

COMPARISION BETWEEN CR

COMPOTED RADIOGRAFITI	DIGITAL NADIOGRAFITY
➤ Filmless technology.	➤ Cassiteless technology.
≻ Works slower.	≻ Works faster.
≻Lesser image quality.	≻Higher image quality.
➤ High radiation dose	≻Less radiation dose
≻Lesser Me span.	≻higher life span.
≻ Simple to used.	≻ Hectic mortality
≻Less costly.	≻ Costly.
Less qualified personal can also function it	➤ Well qualified personal is required.

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Sri Chamundeshwari Medical college Hospital & Research Institute, Channapatna, Karnataka. REF : Christensen's Physics of Diagnostic Radiology, Radiopedia. Christensen's physics of diagnostic radiology