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Question NO: 1
Describe the features of Preprocessing and post processing?

Ans PreProcessing the digital Radiographic image:

1 A principal advantage of digital radiographic imaging over screen-film radiographic imaging is the ability to manipulate the image before and after display Preprocessing.

2 Preimage Processing and Postimage Processing alter image appearance, usually for the purpose of improving image contrast.

3 Preprocessing of digital images is largely automatic.

4 Preprocessing is designed to produce artifact-free digital images.

5 Preprocessing Provides electronic calibration to reduce pixel-to-pixel row-to row, and Column-to-column response differences.

6 The Processes of pixel interpolation, lag correction, and noise correction are automatically applied with most system.

7 offset images and gain images are automatic calibration images designed to make the response of the image receptor uniform.

8 Grain images are generated every few months, and offset images are generated many times each day. These Preprocessing calibration techniques are identified as flatfielding.

9 Averaging techniques also are used to reduce noise and improve contrast.

10 Digital image receptors and display devices have millions of pixels, therefore it is reasonable to expect some individual pixels to be defective and to respond differently or not at all. Such defects are corrected by signal interpolation. The response of pixels surrounding the defective pixel is averaged and that value is assigned to the defective pixel.

Each type of digital image receptor generates an electronic latent image that may not be made visible completely. What remains is image lag, and this can be troublesome when one is switching from high-dose to low-dose techniques, such as switching from digital subtraction angiography (DSA) to fluoroscopy. The solution is application of an offset voltage before the next image is acquired. Some voltage variations may be seen along the buses that drive each pixel. This defect, called line noise, can cause linear artifacts to appear on the final image. The solution is to apply a voltage correction from a row or a column of pixels in dark, unirradiated area of the image receptor.

PostProcessing the radiographic digital Images

Postprocessing is where digital imaging shines. In contrast to preprocessing which is largely automatic, postprocessing requires intervention by the radiologic technologist and the radiologist.

2 Postprocessing refers to anything that can be done to a digital radiographic image after it is acquired by the imaging system.

3 Postprocessing of digital images requires operator manipulation.

4 Postprocessing of the digital radiographic image is performed to optimize the appearance of the image for the purpose of better detecting pathology.

5 Annotations is the process of adding text to an image. In addition to patient identification, annotations is often helpful in informing the clinician about anatomy and diagnosis.

6 By window and level adjustments, the radiologic technologist can make all 65,536 shades of gray visible. This amplification of image contrast may be the most important feature of digital radiographic imaging.

7 The large matrix size digital display devices have better spatial resolution because they have smaller pixels. This allows, among other properties, magnification of a region of an image to render the smallest detail visible. Magnification in digital imaging is similar to using a magnifying glass with a film image.

8 At times, multiple digital images must be flipped horizontally or vertically. This process, called image flip, is used to bring images into standard viewing order. Most digital radiographic images are viewed through the contrast rendition of screen-film images; Bone in white and soft tissue is black. Sometimes pathology can be made more visible with image inversion, which results in a black appearance of bone and a white appearance of soft tissue.

9 Subtraction of digital radiographic images obtained months apart - temporal subtraction is used to - amplify changes in anatomy or disease. The purpose of image subtraction is to enhance contrast.

10 Misregistration of a subtraction image occur when the patient moves during serial image acquisition. This can be corrected by re-registering the image through a technique called pixelshift.

11 Greater use is being made of quantitative imaging, that is, use of the numeric value of Pixels to help in diagnosis. This requires identifying a region of interest (ROI) and computing the mean Pixel value for that ROI.

This is an area of digital imaging that has been identifed as quantitative radiology, it is finding application in bone mineral assay, calcified lung nodule detection, and renal stone identification.

12 Edge enhancement is effective for fractures and small, high-contrast tissues.

13 Highlighting can be effective in identifying diffuse, non-focal disease. Pan, scroll, and zoom allows for careful visualization of precise regions of an image.

Question No: 2

Distingish between spatial resolution and contrast resolution?

Ans

Spatial resolution:	Contrast resolution:
1 Spatial resolution (resolution in space) is the abiliby of an imaging system to resolve and render on the image a small high-contrast object.	→ Contrast resolution is the abiliby to distinguish many shades of gray from black to white. → All digital imaging system have better contrast resolution

2 In medical imaging, spatial resolution is described by the quantity of spatial frequency.

3 Ability to distingish two small high contrast objects located very close to each other under noise free condition.

4 When all of the factors are correct, conventional radiography has excellent spatial resolution.

5 Spatial frequency is expressed in line pair per millimeter (lp/mm).

6 A line pair is a black line on a light background, one line pair consists of the line and an inter-space of the same width as the line.

than screen-film imaging.

→ The principal descriptor for contrast resolution is grayscale, also called dynamic range.

→ Ability to differentiate attenuation cofficients of adjacent areas of tissue.

→ Computed tomography and MRI have excellent contrast resolution. Conventional radiography is fair to poor.

→ Dynamic range is the number of gray shades that an imaging system can reproduce.

→ The Dynamic range of a screen-film radiograph is essentially three orders of magnitude, from an optical density (OD) of near 0 to 3.0. This represents a dynamic rang of 2000, but the viewer can visualize only about 30 shades of gray.

7. A low spatial frequency represents large object, and a high spatial frequency represents small objects.

8. An imaging system with higher spatial frequency has better spatial resolution.

9. The spatial resolution of screen film radiograph is determined by the geometry of the system, especially focal-spot size.

10. Mamography is best of its small focal spot -0.1mm for magnification.

11. MTF is the ability of an imaging system to render objects of different sizes onto an image.

12. spatial resolution in digital imaging is limited by Pixel size.

→ The dynamic range of digital imaging systems is identified by the bit capacity of each pixel.

→ CT and MRI system generally have a 12-bit dynamic range (212 = 4096 shades of gray)

→ Because contrast resolution is a important in mammography, such digital mammography (DM) systems have a 16-bit dynamic range.

→ Post processing allows visualization of all shades of gray.

→ other sources of noise in addition to scatter radiation may be associated with image receptor, regardless of whether it is the screen-film or digital type. Image noise limits contrast resolution.

Question No: 3

Discuss the characteristics of digital imaging that should result in lower patient radiation doses?

Ans Characteristic of Digibial imaging in Patient Radiation Dose Consideration:-

Perhaps the characteristic of digital imaging is the opportunity for patient radiation dose reduction. This occurs because of the linear manner in which the image receptor responds to X-rays and beause of the greate DQE of digital image receptor.

→ With accelaration to all-digital imaging we have the opportunity to reduce Patient doses by 20% to 50%, depending on the examination.

→ Digital image receptor response is linearly related to radiation dose, image contrast does not change with dose. One cannot overexpose or underexpose a digital image receptor. However poor technical factor selection may result in overexposure of the patients. Contrast resolution is Preserved in digital imaging regardless of dose

→ Radiographic technique for screen-film imaging requires.

a) Tha an appropriate kVp be selected on

the basis of the anatomy that is being image.

b That the proper mAs be selected to produce proper optical density on the finished image. For screen-film imaging, kVp controls contrast and mAs controls OD.

→ Exposures should not be repeated in digital radiography (DR) because of brightness or contrast concerns.

→ Digital imaging techniques must be approached differently. Instead of "dose creep", "technique creep" should be used each of the various digital imaging systems. The result will be patient radiation dose reduction.

→ Because digital image contrast is unrelated to dose, kVp becomes less important. When digital examination of specific anatomy is conducted, the kVp should start to be increased and an accompanying reduction in mAs should be noted with successive examinations.

→ The results will be adequate contrast resolution, constant spatial resolution, and reduced patient radiation dose.

The Patient radiation dose reduction that is possible is limited.
The Problem with very low technique for digital imaging is low SNR. Noise can predominate and compromise the interpretation of soft tissue anatomy.
The Probability that an X-ray will interact with an image receptors is determined by the thickness of the capture layer and its atomic composition
The descriptor used for medical imaging is DQE.
DQE is related to the absorption coefficient and to the spatial frequency of the image-forming X-ray beam.
DQE is a measure of X-ray absorption efficiency.
Patient dose in DR should be low because of high DQE.
That the DQE for DR is higher than that for CR or screen-film.
CR has a slightly higher DQE than screen film.

Question No: 4

Discuss the features of an active matrix liquid crystal display?

Ans Active matrix liquid crystal Displays:

- We all know that matter takes form of gas, liquid or solid. A liquid crystal material state between that of a liquid and a solid.
- A liquid crystal has the property of a highly ordered molecular structure a crystal and property of viscosity a fluid.
- Liquid crystal materials are linear organic molecules that are electrically charged, forming a natural molecular dipole, Consequently, the liquid crystals can be aligned through the action of an external electric field.
- AMLCDs are superior to CRT displays.
- AMLCDs are fashioned pixel. The AMLCDs has a very intense white back light that illuminates each pixel.
- Each pixel contains light-polarizing filters and films to control the intensity and color of light transmitted throug the Pixel.
- The differences between color and monochrome AMLCDs involve the design

resorting to film. The projected efficiencies of time and cost are enormous.

- PACS improves image interpretation, Processing, viewing, storage and recall.
- The principal of components of a PACS are the image acquisition system, the display system, the network and the storage system.

* Application of PACS:

The four principal of components of a PACS:

1. Image acquisitions system
2. The display system,
3. The network:
4. The Storage system

1 Image acquisitions system

Image acquisitions system is the creation of a digitally encoded representation of the visual characteristics of an objects, such as a physical scene or the interior structure of an object.

2 Display System:

Display system is the total system, combining hardware and software.

needed to achieve a visible representation of information in a data-processing system.

Networks.

In some countries national networks are used for medical data. All patients have a unique identifier, a number that exclusively their for life.

Storage System:

An entire hospital file room can be accomodated by a storage device the size of a desk. Electronically, images can be recalled from this archival system to any workstation in seconds.

Question No: 6

Discuss the three types of digital radiographic imaging artifacts and how to avoid them?

Artifacts:

An artifacts is any false visual feature on a medical image that simulates tissues or obscures tissue.

Artifacts interfere with diagnosis and must be avoided.

Similar to accidents, artifacts are avoidable.
Artifacts can be controlled when the cause of the artifact is understood.
In screen-film radiological three classification of artifacts occur Processing, exposure, and handling or storage
In digital radiography (DR), three classifications of artifacts can be described - image receptor, software and objects.

Image Receptor Artifacts:
Digital image receptor can suffer from rough handling, scratches and dust
Artifacts Produced by dust can be corrected easily with proper cleaning unless the dust is internal to the optics of a computed radiography (CR) imaging system.
Scratches or a substantial malfunction of pixels likely will require replacement of the image receptor.
Environmental radion can contribute to ghost artifacts.

- Digital radiographic image receptors have unique artifacts associated with pixel failure.

2 Software artifacts:

- Digital radiographic images are obtained as raw data sets.
- As such, these images are ready for "processing".
- For-processing images are manipulated into "for presentation" images that the radiologic technologist can use for QC and for interpretation by the radiologist.

3 Object artifacts:

- Object artifacts can arise from the technologist's errors in patient positioning, X-ray beam collimation, and histogram selection.
- Back scatter radiation also can be trouble some because of the sensitivity of the digital radiographic image receptor.
- If a lot of scattering material is Present behind the image receptor, backscatter radiation can cause a phantom image. Artifact the back side of the image receptor should be shielded to reduce X-rays.

Question No: 7

Describe the basis for data compression and the difference between lossless and lossy compression?

Ans

Basis for Data Compression:

At up to 50MB per image on a 24x 30cm IP(216 and 50+µm pixel size), a four-view digital mammography study can generate 200MB. Transmitting and archiving this amount of data is technically difficult; therefore compression techniques are used. Data compression take advantage of radundancy of data, as occurs with exposure to the raw x-ray beam when all values are the same, such compression techniques are described as loosless or lossy.

Lossy compression

Lossy compression is the family of data encoding method that utilizes imprecise to represent the content.

Lossy compression removes non-useful part of the data that is undetectable.

Lossy compression can decrease the size of the file to a greater extents

The quality of the data degrades in case of lossy compression.

In the lossy technique, the channel accommodates more data.

Lossy compression is used in images, audio and video.

Lossless compression

→ Lossless compression is a group of data compression algorithms that permits the orignal data to be accurately rebuilt from the compressed data.

→ lossless compression reconstructs the exact data.

→ Lossless compression can reduce the size of data at low extents.

→ lossless doesnot degrade the quality of the data.

→ Conversely, channel holds a smaller amount of data in case of lossless technique.

→ Lossless compression is used in textbox Program, images and sound.

Question No: 8

Identify the different for-Processing images and for presentation images?

⇒ For process images are mainpulated for presentation images that the radiologic technologist can use for QC and for interpretation by the radiologist.

⇒ Before an image is prepared for processing several mainpulation of the output of an image receptor may be necessary to correct for potential artifacts.

⇒ such artifacts can occuss because of dead pixels/ dead rows/ columns.

Question NO: 9

Explain how digital radiographic image artifacts occur because of improper collimation, partition and alignment?

Ans

Object Artifacts:

- Object artifacts can arise from the technologist's errors in patient positioning, x-ray beam collimation, and histogram selection.
- If a lot of scattering material is present behind the image receptor, backscatter radiation can cause a phantom image. If this type of artifact is discovered, the back side of the image receptor should be shielded to reduce backscatter X-rays.
- Backscatter radiation also can be troublesome because of the sensitivity of the digital radiographic image receptor.

* Collimation and Partition:

- If the x-ray exposure field is not properly collimated, sized and positioned, exposure field recognition error may occur.

The result is very dark or very light or very noisy images.
Automatic radiation field recognition is essential for artifact-free images.
Collimation of the projected area X-ray beam is important for patient radiation dose reduction and for improved image contrast in screen-film radiography.
In DR, proper collimation has the added value of defining the image histogram, If improperly collimated the histogram can be improperly analyzed, resulting in a artifact.
Proper collimation and centering Prevents histogram error that can lead to artifacts.
If multiple fields are projected onto a single IP, each must have clear, collimated edges and margins between each field. This process called partitioning allow two or more images to be Projected on a single IP.
Partitioning of multiple digital images on a single IP results in Proper separation and collimation of each image.

Alignments

Alignment of the exposure field on the IP is important in the same way and for the same reason as collimation. When an image field, such as that shown is not oriented with the size and dimensions of the IP, image artifacts can appear.