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Question : 1

What is digital
Subtraction Angiography :

Angio → means blood vessels

Angiography → is the radiological study of blood vessel in body after introduction of contrast.

Subtraction → It is simply technique by which bone structures images are subtracted or cancel out from a film of bones plus opacified vessels.



Digital Subtraction Angiography:

⇒ The acquisition of digital fluoroscopic images combined with injection of contrast material and real-time subtraction of pre- and post contrast images to perform angiography is referred to as digital subtraction angiography.

⇒ The idea of subtraction images was first proposed by the Dutch radiologist Ziedses des planten in 1935.

⇒ With introduction of Seildinger techniques in 1953, the procedure became safer as no sharp ovid. devices need to remain inside vascular lumen.

⇒ DSA is a fluoroscopic technique used in interventional radiology.



to clearly visualized blood vessels in a bony or dense soft tissue environment. ”

⇒ Digital technology made DSA practical from 1970s.

Advantages of radiographic

Subtraction:

- (i) Providing image enhancement
- (ii) improving and bringing out detail in areas hidden by overlying bone or poor contrast.

Indications:

Diagnostic Indications:

- Arterial
- Aneurysm
- Pseudoaneurysm
- Tumor vascularity
- dissection or laceration
- Thrombosis
- AVM



Therapeutic indication:

- Embolisation
- Stenting
- Thrombolysis
- Thrombectomy

Contraindications:

- * No absolute contraindication
 - poor renal reserve
 - Deranged coagulogram
 - Allergic to contrast media.

DSA used for:

- DSA used for visualizing blood vessels.
- Radiopaque structures such as bone are subtracted digitally from the image.
- Also used for diagnosis and treatment of arterial and venous occlusions.

⑤

DSA Procedure:

- Digital Subtraction Radiography is used to produce images of blood vessels without interfering shadows from overlapping tissues.
- This provides clear view of vessels.
- The non-contrast image called Mask image of region is taken before injecting contrast.
- Contrast images are taken in succession while contrast material is being injected.
- These images show the opacified vessels superimposed on anatomy and are stored on computer.



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→ The mask image is then subtracted from contrast images pixel by pixel. The resulting subtraction images show the filled vessels.

→ Sequence of subtracted images based on initial mask images.

→ The subtraction images can be viewed in real time.

→ Radiologist control that how much contrast media is injected and for how long.

→ Smaller structures requires less contrast to fill vessels than others.

→ It should be noted that since image subtraction causes a



decrease in signal-to-noise ratio.
→ The inevitable solution to this is to increase mA.

Complications:

(0.61% major rate)

Local complications:

- Hematoma
- Vessel laceration
- Dissection
- Pseudoaneurysm
- AV fistula.
- Local tissue damage.

Systemic complications:

- Contrast reactions
- Dehydration
- Thromboembolism
- Air embolism
- Fever
- Sepsis

CNS Complications:

- Aggravation of Pre-existing Complaints.
- Neurological deficit.

⑧ Question : 2

What is Artifacts: definition:

→ An Artifacts are any false visual feature on medical image.

→ It interfere with diagnosis and must be avoided.

→ It can be controllable when causes of artifacts are understood.

Types of Artifacts:

Three common digital radiographic image artifacts are;

- (i) Image receptor artifacts
- (ii) Software artifacts
- (iii) Objects artifacts.

(i) Image receptor artifacts:

• It occurs due to rough handling, dust and scratches.

• Pixel malfunction

• Ghost images :

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The appearance of Ghost images occurs b/c of incomplete erase of previous image.

Avoidance:

• Artifact produce by dust can be corrected easily with proper cleaning. ~~unless~~

• Scratches or pixel malfunction requires replacement of image receptor.

• Ghost artifacts can be avoided by additional signal erasure technique. IP should be erased again before use.

② Software Artifacts:

• The artifacts produce during development of software.

• In software development life cycle artifacts usually refers to (things) that are produced by people involved in process.

• Examples:

- Document design
- data models
- workflow → test matrices
- setup → script → plans.
- architecture of software.

• Processing artifacts also occur due to dead pixels & row/column of pixels.

Avoidance:

- Before ~~using~~ a image is prepared "for processing" several manipulation of output of an image receptor may be necessary for correctness of artifacts.
- Anti-virus to software also done.

③ Object Artifacts:

These artifacts are arises due to technologist's error in patient positioning, x-ray collimation and also due to histogram selection.

Backscatter also can be troublesome b/c Back Scatter produce phantom images.

How to avoid:

Technologist should be experienced.

Back side of Image receptor should be shielded to reduce backscattering x-ray.

Accurate patient position.

Accurate x-ray collimation.

Question : 3

Disadvantages of DR :

(1) Cost :

One of main disadvantages of DR is high start-up cost but generally it is acceptable due to long term benefits.

(2) Medicolegal:

The ability to manipulate the image for fraudulent purpose.

(3) Cross-infection control:

The intraoral sensor cannot be ~~sted~~ sterilized.

(4) Sensor dimensions:

The sensor is bulky in bulky in size.

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(5) harmful changes:

Any exposure to radiation, no matter how small, has potential to cause harmful biologic changes;

- cause permanent damage
- Genetic Mutation
- cause cancer.

Critical organ :-

- Skin
- Thyroid Gland
- Lens of eyes
- Bone marrow.

A disadvantages of DN is

(6) Size and shape of sensor
also in position of connecting cord.



(7) Image quality:

Human eye can only perceive 8 to 10 lp/mm so debate since regular film radiographers are higher 12 to 20 lp/mm.

(8) Initial setup - maintenance etc:

on the side it does away with darkroom machines, chemicals etc

(9) Legal issue:

Always keep non-enhanced original saved on computer prior to digital image enhancement.

(10) Wear and tear:

(11) Need computer Network:

(12) Overexposure:

Whilst underexposure will give grainy appearance, overexposure is automatically

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corrected by imaging software
so there is a tendency of
overexposure to ensure a
good quality image.

Question: 4

Compare Image Quality OF

Screen film
Radiography

Digital
Radiography

Latitude

- Screen film has a much narrower latitude to get the correct exposure so small changes in photon energy has greater impact.
- DR has greater latitude so image is still acceptable with small changes in photon energy.

Grey-scale

- Grey-scale in conventional offers 16-25 shades of grey.
- Grey-scale of DR offers 256 shades of grey.

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Dynamic range

- » Narrow dynamic range
- » Wider dynamic range.

Spatial Resolution

- » High Spatial resolution
- » Spatial resolution inferior to screen film.

Image format

- » Analogue
- » Discret pixels

Process controls for image quality.

- » Film density
- » Filters, CNR, SNR

Image review

•» Film review with optical magnification

Computer review with image manipulation and analysis tools

Image Time

•» 10-30 mins

Seconds

Image Enhancement

•» Can't Adjust

Software adjust

Image Storage

•» Physical

Electronic

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Solid State Flat panel

- In Digital radiography Solid state flat panel detectors provide better quality of image with less radiation dose compared with Screen film radiography.

mAs & KVP Setting

- | | |
|--|---|
| <ul style="list-style-type: none">→ High KVP Setting results in relatively low-contrast image while | <ul style="list-style-type: none">→ In DR mAs and KVP setting is less influence on contrast and latitude. |
| <ul style="list-style-type: none">→ low KVP in higher contrast images - an effect used for image optimisation in thoracic and abdominal radiography. | |



Underexposure

- \Rightarrow Many faults caused by over and under-exposure which destroy quality of image.
- \rightarrow Carefully adjusted to region of interest and its thickness avoid over/under-exposure.
- Quantum mottle;
 - \rightarrow Significant under-exposure result in a mottle, grainy image due to inadequately low number of photons reaching the phosphor plate.
 - \rightarrow Severe over/underexposure cannot correct and results in image artifacts formation.
 - \rightarrow If overexposure occurs it is largely adjusted automatically.

21 Which One is Superior:

- Van Soldt et al. reported a better image quality with Digital radiography compared to conventional radiography.


Question : 5

Image receptor :

- Image receptor is a device that change an x-ray beam into a visible image.
- Image receptor may be a radiographic film and cassettes, a phosphorescent screen or special detector placed in a table or bunk.

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2 Show Difference of Image receptor in DR & Conventional R.....

Digital image receptors :

- Digital image receptor is in the form of matrix of individual pixel element which work on certain technology like solid state and photo-stimulable phosphor technology.
- Three types of solid state sensors are use charge couple devices (CCD) complementary Metal oxides Semiconductor (CMOS) and Thin film transistor (TFT).
- CCD, CMOS, CMOS-APS are all direct digital image receptor its pixels varies depending on image receptor size and image resolution.



→ PSP and SPP use as indirect receptor, are flexible, wireless receptor similar in size and thickness to film.

PSP:

→ Photostimulable plates^{↑phosphor} are still widely used as receptors in intraoral radiography. They allow indirect image acquisition more specifically after exposure, latent image occurs on the plate, it then convert to digital radiographic image.

CMOS:

→ CMOS is sensitive to light and provides small details in x-ray images by isolating each pixel from its neighbouring pixels.



CCD:

→ The CCD is direct digital image receptor was the first image receptor used in intraoral radiography.

→ CCD uses silicon wafer whose crystals are formed in a picture element pixel. Size of pixel varies from 20 microns to 70 microns.

Flat Panel detector

→ x-ray flat panel detector for digital radiography work by converting x-ray that strikes to surface into light and then turning light into electronic data.

→ They are used in both projectional and radiography.

→ FPD use active matrix of $(Si:H)$

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Conventional image receptor:



Conventional image receptor used for most radiographic procedures contain two intensifying screens mounted one each side of double-emulsion film.



Using two screens in this manner increases x-ray absorption and receptor sensitivity with least amount of image blurring.

Types of image receptor in Conventional Radiography:



Direct-action or non-screen film sensitive primarily to

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to x-ray photons.

→ Indirect action used in combination with intensifying screen in a cassette.

→ This type of film is sensitive primarily to light photons, which are emitted by the adjacent intensifying screens.