III ARDENT Workshop, 2nd October 2014

Quality assurance of X-ray device

1. Introduction: Which parameters influence a clinical image?

With the use of Primus L, make some shot and look at the picture obtained tuning kV, mAs and time.

1.1 Which parameter affects the contrast of the image?
a) kV b) mAs c) time

1.2 For a *soft tissue* which parameter should be decreased?
a) kV b) mAs c) time

1.3 If an image appears too white which parameter is it essential to be tuned?
a) kV b) mAs c) time

1.4 Which parameter influences the dose to the patient?
a) kV b) mAs c) time

2. Part I: Dosimetry – Use of IBA MagicMAx QA System

2.1 *mAs linearity*

Goal: Verify the linearity between air kerma and mAs.
Methods: 5 expositions in the typical clinical range (70 kV, 25 – 200 mAs) and report the air kerma. Verify the linearity with coefficient r > 0.999

2.2 Peak tube Voltage

a. Accuracy and Repeatability

A tube voltage check over the range 50 - 150 kVp should be performed.

If other tube voltages are used clinically then these must be measured also.

The reproducibility is measured by repeated exposures at one fixed tube voltage that is normally used clinically (e.g. 70 kVp).

Accuracy: < ± *5%*

b. kV Waveform (kVp, Mean kVp, PPV)

kVp:

Mean kVp:

PPV:

2.3 Determination of HVL

The Half Value Layer (HVL) can be assessed by adding thin aluminum (Al) filters to the X-ray beam and measuring the attenuation.
Position the exposure detector at the reference point (since the HVL is position dependent) on top of the bucky.
Select 80 kV tube voltages and an adequate focal spot charge (mAs-setting), and expose the detector directly.
The filters can be positioned on the compression device and must intercept the whole radiation field.

Use the same tube load (mAs) setting and expose the detector through each filter.
The HVL is calculated by applying formula:

$$HVL = \frac{X_1 \ln(\frac{2Y_2}{Y_0}) - X_2 \ln(\frac{2Y_1}{Y_0})}{\ln(\frac{Y_2}{Y_1})}$$

3. Part II: Image Quality – Use of IBA MagicMax QA System

The information content of an image may best be defined in terms of just visible contrasts and details. The basic conditions for good performance and the constancy of a system can be assessed by measurement of the following: resolution, contrast visibility, exposure time.

3.1 Spatial Resolution

Limiting value Acceptable: > 1.2 lp/mm

3.2 Image Contrast

The image contrast is defined by counting the visible steps in the phantom.
It has to be recorded the tube voltage, the current and the dose rate.
Tune the settings in order to have the maximum visibility.

Clinical conditions: 70 kV, 30 mm Al, Automatic exposure 5 µGy

3.3 AEC System

The AEC system should ideally provide constant optical density regardless of kV selected, mA selected or patient thickness being imaged.
The performance of the Automatic Exposure Control (AEC) system can be described by the reproducibility and accuracy of the automatic optical density control under varying conditions, like different object thickness and tube voltages, in alternative the air kerma.

- Kerma at the AEC chamber should be reproducible
- *Exposure time shorter than 10 ms*