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Protocol for constancy control of digital mammography equipment

Digital equipment is increasingly used in mammography. To ensure high quality mammograms, frequent quality control tests - "constancy control", are important. In 2007, the Norwegian Radiation Protection Authority (NRPA) developed a first draft for a constancy control protocol for digital mammography equipment. Nine centres in the Norwegian Breast Cancer Screening Program (NBCSP), with seven different system models from four different manufacturers, tried out the protocol in 2008. After a meeting of all the participating facilities in January 2009, the first official version of the protocol is now available.

Constancy controls

Constancy controls are frequent (daily, weekly) technical tests of mammography equipment performed by radiographers. With an ever increasing number of digital mammography systems in use, there was a need to supplement the test protocol for *analogue* (film based) mammography systems [1] with a protocol for digital systems.

Constancy control protocol for digital mammography systems

In 2007 the NRPA suggested a protocol for constancy control of digital mammography systems. The draft was based on similar protocols published by others [2,3,4] and was sent to facilities in the NBCSP experienced in digital mammography. A revised version was presented and discussed at a meeting for radiographers and medical physicists in December 2007.

Trial

To determine whether the test procedures were appropriate, the suggested tolerance levels reasonable and the test regimen feasible, a trial was conducted in 2008. Nine breast diagnostic centres contributed data from measurements on 19 digital mammography systems representing seven different system models from four manufacturers. Prior to inclusion in the project, a special training session was conducted at each facility. Test results were sent to the NRPA every month. After the termination of the project, the data was analysed

Pre-trial training in Rogaland

and presented on several occasions, including at the RSNA (Radiological Society of North America) 2008. All participating facilities were invited to a concluding meeting in January 2009. Based on the trial results and the discussions at this meeting, the first "official" version of the protocol was completed in February 2009.

Tests in the protocol

- Mammography system
  - Daily control of AEC (Automatic Exposure Control)
  - Simple evaluation of image quality at different breast thicknesses
  - Evaluation of artifacts
  - Evaluation of detector uniformity
  - Exposure control steps
  - Compression
  - Alignment of light field and radiation field

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- Viewing conditions/monitors
  - Room layout/light sources
  - Control of monitors (daily)
  - Control of viewing monitors (weekly)
- Printers
  - Daily printer control
  - Resolution
  - Optical density range
- Patient doses

For computed radiography (CR) systems a few additional tests are suggested.

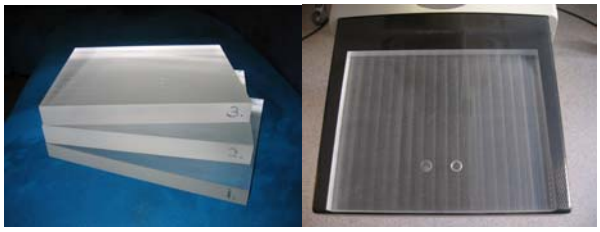
The newconstancy control protocol.

New test object

A new test object has been developed and is used in several of the tests in the protocol. The test object consists of three PMMA (poly(methyl methacrylate)) slabs covering the entire detector: one slab with thickness 20 mm, the other two with thickness 25 mm. One of the 25 mm slabs has a flat-bottomed circular depression drilled into it and also the outline of a circle with the same area. Together the two slabs without depression constitute a uniform 45 mm phantom. The slab with the depression is used either alone, or together with one or both the other slabs to create images used in an evaluation of the signal difference to noise ratio at three different phantom thicknesses.

Other constancy control protocols

For analogue mammography systems there are



Test object consisting of PMM slabs.

”universal” protocols for constancy control, meaning that more or less the same tests are used regardless of equipment manufacturer and country. Such protocols have developed over time. Similar protocols did not exist when digital mammography systems entered the market at the turn of the millennium. The need for control, however, did not vanish and the lack of universal guidelines was compensated for by each manufacturer developing their own protocols. These contain both manufacturer-specific elements and procedures that more or less overlap with ours and/or those of other manufactureres.

We regard the development, testing and publication of “Protokoll for konstanskontroll av digitale mammografisystemer” [5] as a first step towards a “universal” test regimen also for digital mammography systems. Others work towards the same goal. It will, however, take time before this goal has been reached. During this interim period, the existence of parallel, partly overlapping, protocols will have to be accepted.

References

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