Comparison of Full Field Digital (FFD) and Computed Radiography (CR) mammography systems in Greece

M. Kalathaki*, C.J. Hourdakis, S. Economides, P. Tritakis, N. Kalyvas, G. Simantirakis, G. Manousaridis, I. Kaisas and V. Kamenopoulou

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* mkala@eeae.gr
Introduction

The transition from film screen to digital mammography has been very evident the last decade in the field of early diagnosis of breast abnormalities. Digital mammography provides advantages involving improved image contrast, the potential of reduced dose, elimination of film processing, reduction of retakes and the ability to store and transfer images worldwide.

Various types of detectors have been widely used to produce digital images including flat-panel amorphous silicon detectors, amorphous selenium detectors, scintillators with charged coupled devices and photostimulable phosphor imaging plates (computed radiography).

In Greece during the last three years the use of digital imaging in the field of mammography has rapidly increased. The purpose of this study is to evaluate and compare the performance of Full Field Digital (FFD) and Computed Radiography (CR) mammography systems in respect to dose and image quality.
Materials & Method

- Entrance Surface Air Kerma (ESAK) measurements were performed according to the European protocol on dosimetry in mammography with appropriate dosimeter and by using a Gammex RMI 156 mammographic phantom. The measurements were conducted during the regular onsite inspections performed by the Licensing and Inspections Department of Greek Atomic Energy Commission.

- The exposures were performed according to the clinical protocol of each laboratory for a craniocaudal view and a standard size breast.

- The image quality was assessed by the total score of resolved phantom structures incorporated in the phantom.

- The distributions of ESAK and total score (image quality) were plotted and a statistical analysis (two sample t-test) was also performed to evaluate the significance of the outcomes.
Results

- 52 mammography systems of various manufacturers were evaluated in terms of ESAK and image quality
  - 50% of which involved FFD systems and
  - 50% CR modalities.
Results

**ESAK measurements**

- The **ESAK** values for the FFD systems ranged from **2.04 mGy** to **10.27 mGy** with a mean value of **4.59 ± 1.93 mGy**

- The **ESAK** values for the CR systems ranged from **1.91 mGy** to **9.34 mGy** with a mean value of **5.0 ± 1.78 mGy**
Results

**Image Quality Evaluation**

- The evaluation of image quality for FFD systems indicated a range of total score between 11.0 – 14.5 with a mean value of 13.04 ± 0.89.

- The evaluation of image quality for CR systems indicated a range of total score between 9.0 – 13.5 with a mean value of 11.54 ± 1.06.
Results

**Ratio of total score over ESAK**

- The *ratio of total score* (image quality) over ESAK was also calculated indicating:
  - a range between 1.07 – 6.32 with a mean value of 3.27 ± 1.18 for FFD systems
  - a range between 0.96 – 5.76 with a mean value of 2.69 ± 1.20 for CR systems

![Distribution of Total Score/ESAK for FFD and CR systems](chart.png)
## Results

Table 1: Results of two independent samples t-tests

<table>
<thead>
<tr>
<th></th>
<th>t-test for ESAK</th>
<th>t-test for total score</th>
<th>t-test for ratio of total score over ESAK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (mGy)</td>
<td>St. deviation</td>
<td>t - score</td>
</tr>
<tr>
<td>FFD</td>
<td>5.003</td>
<td>1.9344</td>
<td>0.808</td>
</tr>
<tr>
<td>CR</td>
<td>4.587</td>
<td>1.7802</td>
<td>0.808</td>
</tr>
</tbody>
</table>
Conclusions

- Statistical analysis indicated that FFD systems provided a statistically significant better image quality than CR systems. Comparison of the mean ESAK values showed that FFD systems provided slightly lower doses than CR without however indicating a statistical significance at a 5% confidence level. This was also the case for the ratio of total score over ESAK for FFD and CR systems.

- Moreover, 98% of all systems examined (both FFD and CR) met the image quality requirements of Gammex RMI 156 phantom (minimum total score of 10).

- In addition, 85% of all systems examined (both FFD and CR) yielded a dose below the national DRL for mammography examinations.

- Finally, it was observed that the main problem for most of the systems exceeding the national DRL was the non-optimum adjustment and use of the dynamic range of the detectors providing unnecessary higher exposures than clinically needed.
Greek Atomic Energy Commission
P.O BOX 60092
Ag. Paraskevi 15310, Greece

T: +30 210 650 6700
F: +30 210 650 6748
E: info@eeae.gr

http://www.gaec.gr