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Improvement of mammography practice due to implementation of comprehensive quality control programme

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Introduction

The objective of mammography is to obtain the best possible diagnostic information while keeping the radiation dose to the breast as low as reasonably achievable [1]. Fulfilment of these demands applies to every mammogram and as such requires a comprehensive quality assurance/quality control (QA/QC) programme. At the University Hospital Rijeka the QC programme in mammography was implemented in 2013. The programme is based on European Commission guidelines [2] and Croatian radiation protection law.

Materials and methods

The performance levels of mammography practice prior to and following the implementation of the QC programme were compared. Before implementing the full QC programme minor corrections were made. Technologists were trained to use the automatic exposure control mode (AAEC) instead of the advanced automatic exposure control mode, because the AAEC mode was not well adjusted and provided a higher dose than necessary. In addition, weekly screen cleaning was introduced while the development of unit maintenance, the optimisation of unit and chemical development, and the optimisation of the film-foil system was implemented. The radiologist's room was also darkened. Afterwards, QC, including frequency of tests, typical values and tolerances, was implemented according to EC guidelines. The image rejection rates obtained in UH Rijeka, as well as the causes of rejection before and after QC implementation, were compared and analysed. Rejected image analysis is performed twice a year, within two weeks. The purpose of performing quantitative analysis of film rejection causes is to detect the most common problems.

Image quality was evaluated using a QUART Mam/Digi EPQC phantom and a Leeds TOR(MAM) phantom. The reliability of the processing unit was assured by performing measurements of image developing parameters on a daily basis. Beam parameters and dosimetric measurements were performed using a Piranha multimeter (RTI Sweden).

Results

The comparison of results before and after QC implementation showed significant improvements in the consistency of developing parameters. Using the film sensitometric curve, a mean gradient, speed index and contrast index were calculated on daily basis. Prior to the implementation of the programme, image developing parameters varied over time because the chemicals were incompatible with the developing machine. Following QC implementation only chemicals that match our developing unit are used. Results before and after full QC implementation are shown in the graphs (Figure 1, Figure 2). Other characteristic parameters in mammography before and after implementing the QC programme are shown in Table 1.

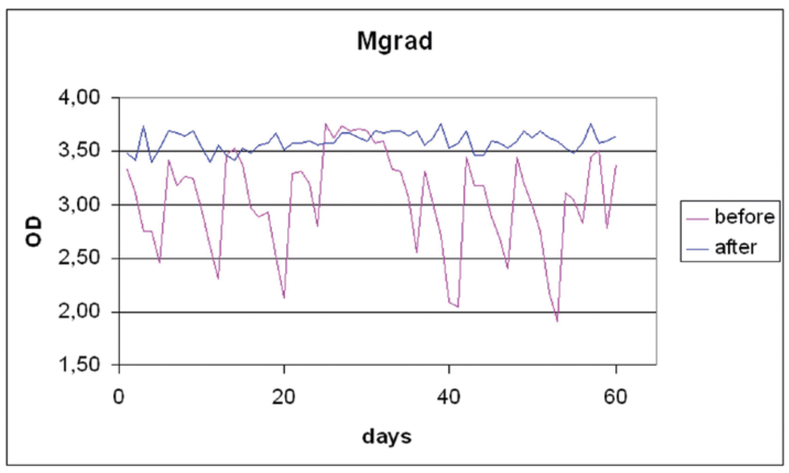

Fig. 1: M_{grad} values before and after QC implementation

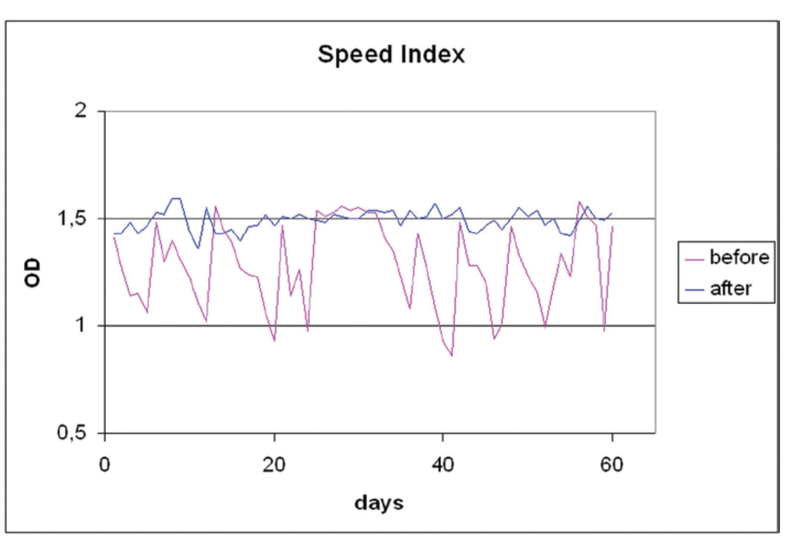

Fig. 2: Speed Index values before and after QC implementation

Tab. 1: Characteristic parameters of mammography before and after implementing the QA/QC programme and comparison with tolerances and typical values

Parameter	Before QC	After QC	Tolerance
Optical density	1,15 OD	1,60 OD	1,3 < OD < 2,1
Luminance of viewing box	1600 - 1700 cd/m²	3000 - 6000 cd/m²	> 3000 cd/m²
Ambient light	55 lux	15 lux	< 50 lux
Resolution	10 lp/mm	16 -20 lp/mm	> 12 lp/mm
Contrast	> 1,5 %	< 1,5 %	< 1,5 %
AGD	1,04 mGy	1,34 mGy	< 2 mGy
Image reject rate	4,68 %	2,05 %	Achievable < 3 % Acceptable < 8 %

Before QC implementation optical density values of images were lower than recommended [2].

A lighter image was used because the luminance of old viewing box was too low. A Mammography viewing box was acquired and OD of the images increased (Figure 3). Consequently, the average glandular dose also increased but image quality improved. The ambient light of the room dedicated for mammography was also beyond tolerance. The room was darkened and the ambient light is now within criteria. For image quality tests, a mammography phantom QUART Mam/Digi EPQC was imaged and the resolution and contrast were evaluated. Before QC resolution and contrast were both out of tolerance and they now meet criteria [2]. The quality of images used before and after QC implementation was also scored by six radiologists using a Leeds TOR(MAM) phantom (Figure 4a, 4b). The analysis of phantom images relies upon scoring according to the visibility of details. Scoring schemes have been proposed whereby the observer allocates a value according to visibility of the test details (i.e., 0 = detail not seen, 1 = barely visible/threshold, 2 = less visible/faint, 3 = detail easily seen). Groups of test details in image with 1.15 OD were scored 20-30% lower than groups in image with 1.60 OD.

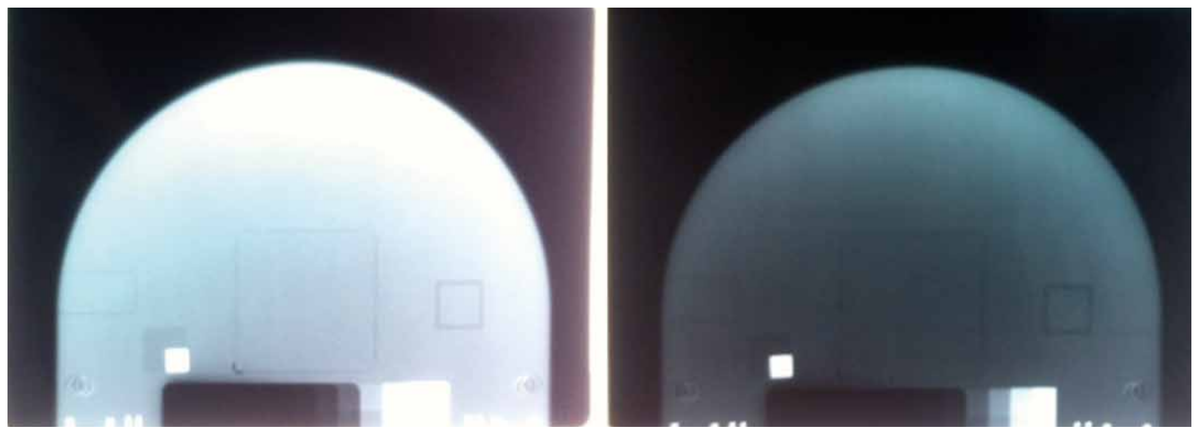

Fig. 3: Image with OD 1,15 used before QC implementation and image with OD 1,60 used after QC implementation, both on new, mammography dedicated viewing box

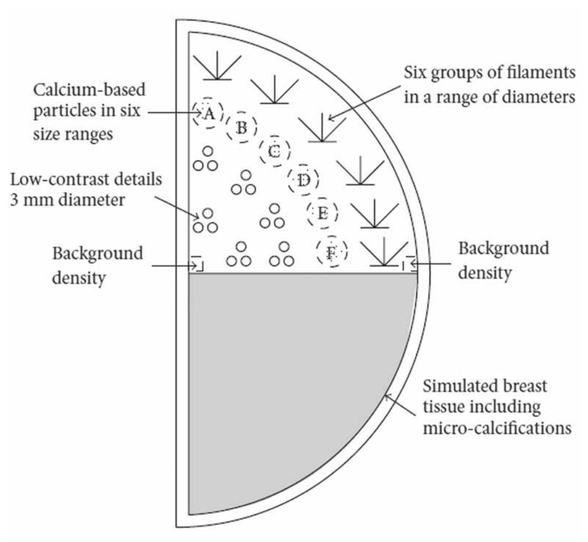

Fig. 4a: Leeds TOR(MAM) phantom

Fig. 4b: Image of Leeds TOR(MAM) phantom

Rejected image analysis was performed within two weeks. Results show that after QC implementation the number of repeated images was lower than before. The purpose of performing quantitative analysis of film rejections causes is to detect the most common problems.

Conclusion

Mammography is, in a technical sense, one of the most demanding radiographic procedures.

Introducing corrective actions into clinical practice can considerably improve mammography image quality and the benefits can be seen very soon.

References
1. Jacobson, D.R. Mammography radiation dose and image quality. Radiat. Prot. Dosim. 80, 295-297 (1998).
2. European Commission. European Guidelines for Quality Assurance in breast cancer screening and diagnosis, 2006, 4th edition
3. Dance, DR., Skinner, CL., Young, KC., Becketh, JR., Kotre, CJ. Additional conversion factors for the estimation of mean glandular dose using UK mammography dosimetry protocol. Phys.Med.Biol. 45, 3225-3240 (2000).