Chapter 1

Background and Purpose
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Amorphous silicon-based electronic portal imaging devices (a-Si EPID) are routinely used for patient set-up verification, which represents a worldwide tool for in-treatment quality assurance (QA).

An important drawback of these detectors is that they suffer from radiation damage during routine clinical use. This results in a degradation of image quality over time. In order to guarantee continued image quality, tests are required to determine whether the panels should be replaced.

By use of small QA phantoms, e.g. QC-3V, several physical parameters are evaluated to quantify the EPID image quality (i.e. spatial resolution and contrast-to-noise ratio). As portal images can cover larger areas and EPID locations, the new trend of analysis and methods should be able to quantify the clinical impact of the artefacts that become present in the images as the panel gets damaged.

This thesis will focus on the Elekta iViewGT® a-Si EPID system performance over time, by looking into physical parameters variations which can be related to the image quality. The degradation of the image quality in time by means of damage in the flat panel structure should be quantified for larger EPID matrix areas under controlled acquisition conditions.

The developed tests and methods for system performance quantification should be correlated to the psychophysical evaluation of clinical portal images in the time trends.

For predicting the a-Si EPID damage and the end-of-life, different approaches were used for quantification and comparison:

- QC-3V phantom physical parameters: spatial resolution and contrast-to-noise ratio;
- Spatial resolution by using an Edge Response Technique;
- System noise by using a Subpanel Image Noise technique;
- System sensitivity by Non Average Pixel response;
- Subjective clinical evaluation.

The described tests to be followed in time should be suitable to answer specific questions:

- The QC-3V phantom is reliable for damage detection over larger EPID areas?
- Which physical parameters could be related to EPID damage in time?
- Can we chase life line and predict the end-of-life by correlating physical parameters to clinical usability?

The understanding of EPIDs behaviour in time, by using described approaches, will be able to define EPIDs lifeline and introduce quality control limits for an accurate clinical usability, based on the correlation of physical parameters and the end-of-life.