

## Dosimetric Verification of Intensity Modulated Radiotherapy with an Electronic Portal Imaging Device

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10 In the Erasmus MC a dosimetric QA program for IMRT is being developed that should guarantee for each individual patient that deviations between the delivered dose distribution and the distribution according to the treatment plan as approved by the physician are below accepted tolerances. Apart from the daily dosimetric linac QA with EPIDs, for each individual patient the procedure basically consists of two steps: 1) the calculated 3D TPS dose distribution is verified with an independent 3D dose calculation engine, using the plan parameters as established with the TPS (gantry angles, MU, leaf trajectories, etc.) as input, and 2) at the linac EPID measurements are performed for each field to verify execution of the plan according to planned parameters. The first step ensures that correct execution of the plan will indeed result in the planned dose distribution, while the second step ensures the correct execution. The aims of this thesis were to develop and evaluate EPID tools for the daily linac QA and for step 2) of the protocol for individualized dosimetric QA. To allow routine clinical use, the developed tools had to be robust, accurate, automated, easy to use, and fast. As a first step, differences between EPID signals and corresponding water doses in high dose gradient areas were investigated. For daily linac QA, fast (several minutes) and very high precision procedures were developed and clinically tested for both dynamic multileaf collimation and for segmented IMRT. For some patients with non-conventional (IMRT) beam angles, the clinical EPID images demonstrated substantial beam attenuation (15%) for components of commercially available (carbon fiber) couch inserts and immobilization devices. Deviations between “in-vivo” measured portal doses and predictions may be caused by errors in the delivered fluence profiles or by differences in the patient anatomy during planning CT acquisition and treatment delivery. For accurate “in-vivo” verification of the delivered fluence profiles, independent of changes in patient anatomy, a technique called Split IMRT Field Technique (SIFT) was developed. SIFT allows assessment of the actually delivered IMRT fluences profiles with an accuracy of 1-2% even in case of large patient anatomy changes. Due to the developed EPID-based procedures, a high level of (multiple 2D) treatment verification could be realized with the available manpower and with only marginal increases in treatment times. Alternative measurement tools as often mentioned in published QA protocols would only allow point measurements (TLD, ionisation chamber, diode) or would be impractical because of time consumption (TLD, film). Currently, all our routine QA measurements for IMRT are performed with EPIDs.

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