Reducing uncertainties in radiotherapy treatment delivery using an electronic portal imaging device

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Abstract

Radiotherapy patients are increasingly being treated with advanced treatment techniques, like intensity modulated radiotherapy (IMRT). With those techniques the delivered dose can often be conformed more closely to the tumor volume, while reducing the dose delivery to surrounding normal tissues. For reliable application, accurate patient positioning is mandatory because of the steep dose gradients outside the tumor volume. Due to the increased complexity of the treatment techniques, verification of the dose delivery before and during the actual patient treatment is increasingly important as well.
In our clinic a quality assurance program has been established for this purpose that is mainly based on measurements with electronic portal imaging devices. To minimize systematic set-up errors, the patient positioning is measured in the first few treatment fractions and a set-up correction for the succeeding ones is derived. Before the first treatment fraction, portal dose measurements are performed for each treatment field to verify that the planned fluence distribution is correctly delivered at the treatment unit. Dosimetric measurements are also performed during patient treatment to derive the actually delivered fluence maps. By combining this information with knowledge on the patient set-up, the actually delivered 3D dose distribution to both the tumor and sensitive organs may be assessed. However, for the highest accuracy, exact knowledge on the (internal) patient geometry during treatment, e.g., using a cone-beam CT, is required.
The quality assurance program and its impact on the accuracy in radiotherapy treatment delivery will be discussed using clinical examples.