

# A method for predicting results of $\gamma$ -evaluation of portal dose images in pre-treatment QA of dynamic IMRT-plans



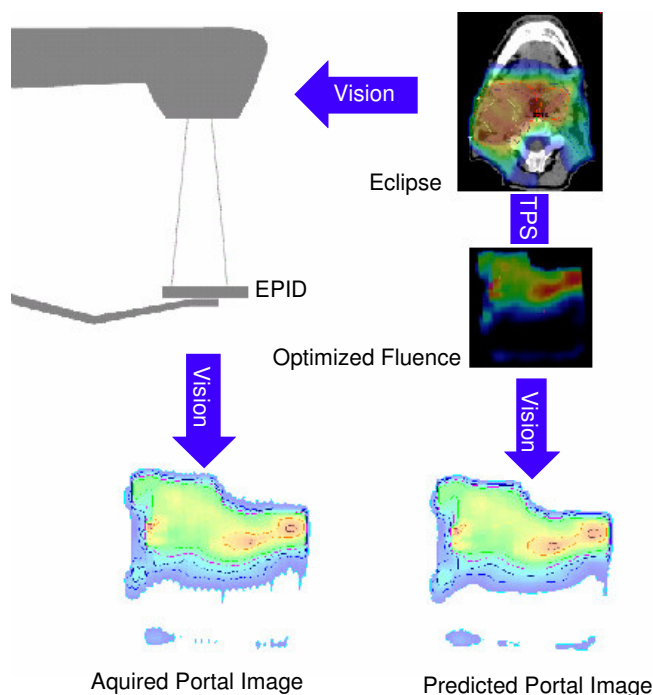
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## INTRODUCTION

During the last year 75 patients with head and neck cancer were treated in our clinic using sliding window IMRT. All plans were planned using the TPS Eclipse (Varian Medical Systems, Palo Alto). Pre-treatment QA was performed using an aSi electronic portal image device (EPID). Dose images were calculated using the portal dose calculation (PDC) algorithm of Eclipse. To be able to predict the outcome of the  $\gamma$ -evaluation of the IMRT-fields during the planning process, an investigation of the correlation between the result of the  $\gamma$ -evaluation and a certain planning parameter in Eclipse was made. The purpose is to make it possible to focus the portal dosimetry QA on the IMRT-plans supposed to give a poor  $\gamma$ -evaluation.

## IMRT PLANNING PROCESS

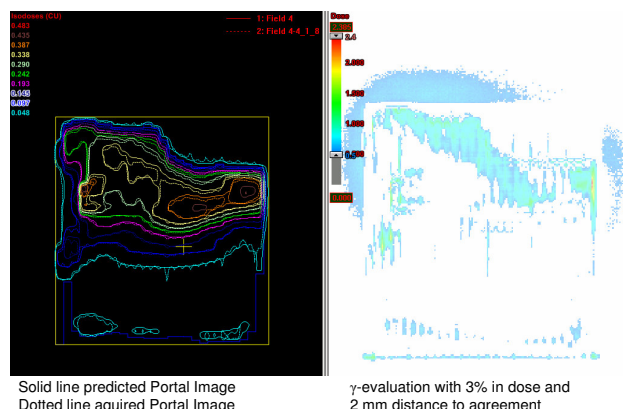
The IMRT plans were made using dose constraints and planning priorities from the DAHANCA IMRT guidelines [1]. The techniques used were primarily 6 field coplanar for patients with bilateral lymph node irradiation and 3 to 4 fields for ipsilateral irradiation. In the planning process standard values of smoothing parameters were used. After the calculation of the optimal fluence Eclipse calculates the dynamic leaf motion using the leaf motion calculator (LMC). The LMC calculates a MU-factor for each field, which is higher for fields with very irregular fluencies. The step and shoot analogue to the MU-factor is the number of segments used to deliver the intensity profile divided by the number of intensity levels. For exact definition of the MU-factor see [2].



A verification plan is made in Eclipse for the portal dosimetry QA. The plan includes portal image predictions and treatment fields. The treatment fields are delivered to the EPID, which is calibrated according to standard Varian procedure [2].

## PORTAL DOSE IMAGE ANALYSIS

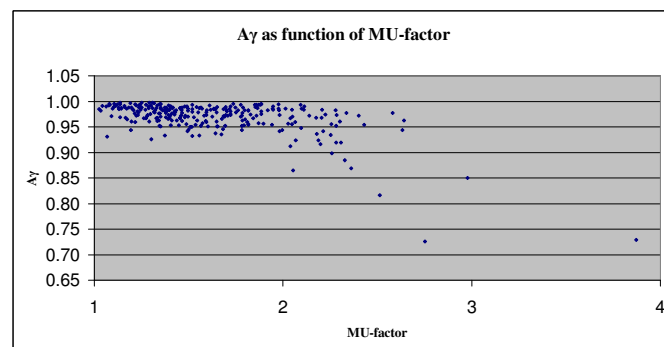
Portal dose images were acquired for each field and evaluated using  $\gamma$ -criteria of 3% in dose and 2mm in distance to agreement. The  $\gamma$ -evaluation was carried out using the review module of Vision. It gives a score, which is the fraction of the total area of the EPID, where the  $\gamma$ -criteria is fulfilled (i.e.  $\gamma < 1$ ). It is only reasonable to investigate that part of the EPID covered by the actual field. Hence a new parameter  $A_\gamma$  is defined.  $A_\gamma$  is the part of the EPID covered by the field, where the  $\gamma$ -criteria is fulfilled divided by the field size.



Stripes in the  $\gamma$ -evaluation corresponds to the tongue-and-groove effect, which Eclipse does not account for.

## RESULTS AND DISCUSSION

From the 75 patients about 300 fields are analysed giving sets of  $A_\gamma$  and MU-factor plotted in the figure below.



A criteria of  $A_\gamma > 95\%$  is fulfilled for 95% of the fields where the MU-factor is less than 2. Generally the area where the criteria is not fulfilled is due to the tongue-and-groove effect or very steep dose gradients. Factors affecting the measured dose are the absolute calibration of the machine and the pixel calibration of the EPID. For MU-factors exceeding 2 the  $\gamma$ -evaluation of many of the fields is not acceptable due to the poorer accuracy of the calculation of dose from the very small fields used to deliver the very complex fluencies. Further more you might get dynamic MLC-motions, that are difficult to deliver.

One of the plans has one field with a MU-factor of 3.9, and  $A_\gamma$  of 73%. This plan has been replanned as a consequence of the  $\gamma$ -evaluation.

[1] DAHANCA 2003 RETNINGSLINIER FOR STRÅLEBEHANDLING AF HOVED-HALS  
CANCER inklusiv IMRT vejledning: <http://www.dahanca.dk>

[2] Varian Medical Systems: Planning Reference Guide for Eclipse Algorithms. Eclipse 6.5