REGION VÄSTRA GÖTALAND
SAHLGRENSKA UNIVERSITY HOSPITAL

Sahlgrenska University Hospital

Dosimetric effects from high density markers for prostate cancer treatments

Authors: Marcus Krantz[1]*. Angela Lund[1] and Roumiana Chakarova[1]
[1]Dep. of Medical Physics and Biomedical Engineering. Sahlgrenska University Hospital. Gothenburg. Sweden

Objectives

The aim of this work was to quantify the dosimetric effects from high density markers on dose distributions for prostate cancer treatments using three different algorithms.

Introduction

Implanted high density gold markers are used in radiotherapy of prostate cancer for a more accurate delivery of planned target dose. The presence of high density markers inside the prostate causes artefacts in the CT images from which the dose calculations are based on.

Materials and methods

About 200 patients treated with volumetric modulated arc therapy for prostate cancer were included. Dose calculations were executed using the treatment planning system algorithms: AAA and Acuros XB (AXB) and by a Monte Carlo (MC) system. Dose volume histogram (DVH) estimates such as the mean dose to the clinical target volume (CTV), the planning target volume (PTV), $D_{98\%}$ PTV and $D_{2\%}$PTV (dose to xx% of the PTV) were evaluated. CT artefacts were identified as regions around the markers with Hounsfield units (HU) outside [-40;60] (Fig 1). Further analysis was performed by setting the HU of the PTV to zero.

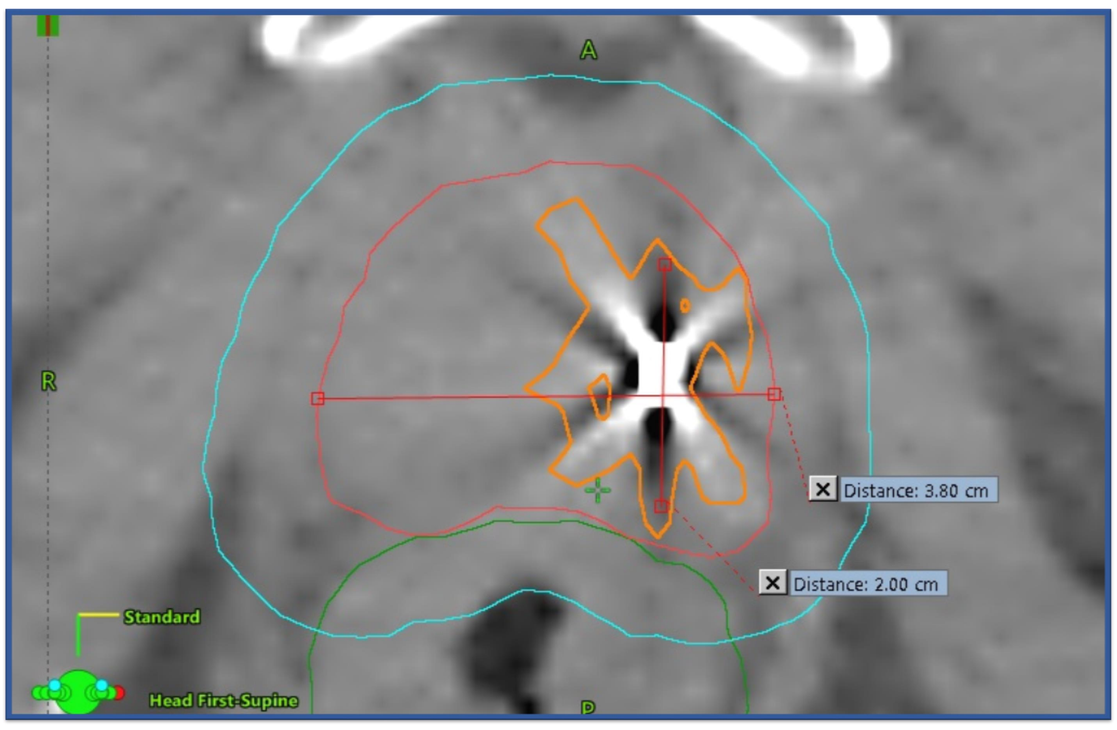

Fig. 1. HU based segmentation of typical CT artefacts. PTV (blue), CVT (red) and an estimate of artefacts and high density markers (orange) is contoured.

Table 1. Relative mean values (in percent). Dose to water and dose to medium, denoted ”w” and ”m”, was obtained for 212- and 20 treatment plans, respectively.

	AAA	AXB_w	MC_w	AXB_m	MC_m
D_{mean}CTV	*100.0*	*100.4*	*100.2*	99.1	99.8
D_{mean}PTV	*100.2*	100.5	100.1	99.7	100.1
$D_{98\%}$ PTV	*96.8*	96.2	95.3	95.7	95.2
$D_{2\%}$ PTV	*102.5*	103.3	103.5	103.0	103.7

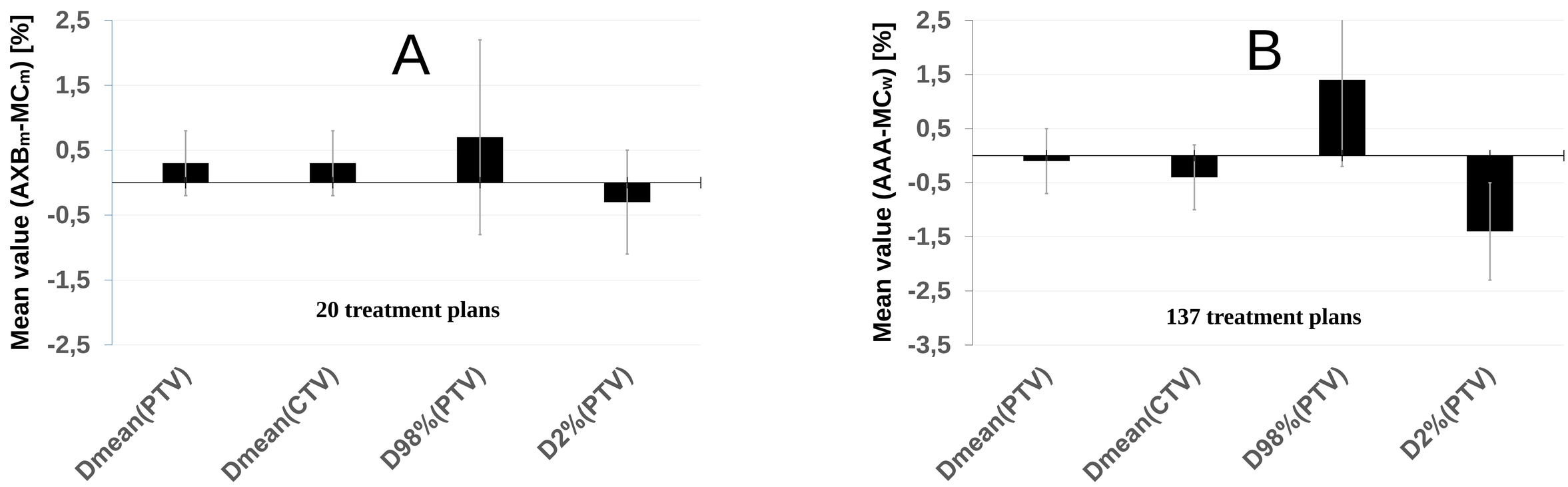

Fig 2. Mean differences between AXB_m and MC_m (**A**) and AAA and MC_w (**B**) for calculated DVH parameters and the corresponding one standard deviation.

Results

Mean values of the calculated DVH parameters are listed in Table 1. AAA, AXB and MC estimations of the mean dose to the CTV and PTV agreed within 0.5% for all cases. Deviations up to 2% were observed for individual plans, notably with gold markers. Deviations up to 5%, related to the shape of the DVH, were detected for $D_{98\%}$PTV and $D_{2\%}$PTV. The volumes of the CTV and the CT artefacts showed no significant impact on the dose deviations. The standard deviations of the dose differences for HU modified PTV tended to be smaller than for the original CT.

Conclusions

The presence of gold markers increased the variation between CTV and PTV dosimetry parameters obtained by different algorithms. However, no clinically relevant dosimetric effects were found to arise from the CT artefacts caused by high density markers.

Presented online and as a physical poster at ECMP 2nd. 23-25 August 2018, Copenhagen, Denmark.*Corresponding author: marcus.krantz@vgregion.se