Purpose/Objective: Superficial PTVs that extend close to or even involve the skin pose great difficulty for inverse planning algorithms. There is known uncertainty in build up and surface doses in treatment planning systems. To address this problem, a typical clinical protocol may consist of PTV-cropping or adding bolus. The rationale for this is to ensure a more accurate dose calculation near the surface and adequate coverage of the PTV. In attempting to cover the build-up region the optimizer can result in a solution that leads to excess fluence delivered by tangential beam segments near the surface. Patient motion or setup errors that bring the target into the region of high fluence, may lead to excess dose near the patient's skin. The goal of this study is to optimize PTV-cropping or bolus thickness so as to (1) achieve optimal coverage of the PTV and (2) dampen the effect of excess tangential fluence associated with inversely-planned helical tomotherapy treatments.

Materials and Methods: We used a commissioned Monte Carlo (MC) model of the helical tomotherapy unit within the McGill Monte Carlo treatment planning (MMCTP) system to recalculate tomotherapy optimized plans in sarcoma patients. The model consists of an accurately benchmarked accelerator model including the binary MLC coupled to a EGSnrc/dosxyznrc calculation of the patient dose distribution in a CT representation. Five patients were MC recalculated in planned setup and with introduced setup error obtained from the daily MVCT imaging.

Results: Fig. 1a shows the surface dose along the blue line for: (1) tomotherapy plan, (2) MC recalculated plan, and (3) MC recalculated plan with introduced setup error. The tomotherapy skin dose is overestimated by 12% compared to the MC recalculated dose. The dose in proximity to the surface is increased by 10% with respect to the tomotherapy dose due to excess fluence near skin if setup errors on the order of 5 mm are considered. Fig. 1b shows the surface dose along the blue line with 1 cm bolus for the: (1) tomotherapy plan, (2) MC recalculated plan. The tomotherapy skin dose is overestimated by only 2% compared to MC. The use of bolus also eliminates skin overdose caused by setup errors and excess fluence.

Conclusions: We used accurate MC calculations to (1) design treatment planning strategies that improve plan robustness with respect to patient motion and setup errors; (2) evaluate the use of 'planning-bolus' (bolus used only for planning and not for treatment) and the actual delivered dose to the PTV in the patient treated with no bolus; (3) evaluate the necessary buildup or PTV cropping so that the dose to PTV is accurately calculated and the excess fluence near patient's surface is dampened. Our study shows that the amount of overlying material on the PTV must be at least 5 mm (by PTV cropping or bolus). A 'planning bolus' strategy improves plan robustness and eliminates excess fluence. PTVs cropped less than 4 mm from skin are sub optimally covered.

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EP-1455
Accuracy of volume reconstruction and calculation with different external beam treatment planning systems
A. Perez-Rozos1, J.F. Calvo-Ortega1, M. Lobato Muñoz1, J. Casals2
1Hospital Virgen de la Victoria, UGC Oncologia, Malaga, Spain
2Hospital Quiron, Departamento de Radioterapia, Barcelona, Spain

Purpose/Objective: To determine 3D reconstruction volume calculation in several modern external beam radiotherapy treatment planning systems, with focus on stereotactic radiosurgery.

Materials and Methods: Five SRS patients were selected and contoured using BrainLab iPlan (volume is evaluated in contouring and planning tasks). GTV, CTV, PTV and organ at risks were contoured, exported using DICOM protocol, and imported in Varian Eclipse v.10, Philips Pinnacle v.9.8, Elekta Oncentra v.4.1 (manual and automatic customization) and Monaco v.3.3 (contouring and planning tasks), Mobius3D v.1.3 and one non clinical use software (CERR v.3.3). Volumes (cm3) were calculated for reconstructed 3D contours in every TPS and then compared using mean, maximum and minimum volume between TPSs calculated volume and mean calculated volume.

Results: Figure 1 summarize results for different TPS and clinical structures of different volumes. Higher spread of volume calculation is found in smaller volumes, mainly due to volume grid calculation, differences in voxel assignments and first and last contour management. This differences reach as much as 60% of mean volume for some TPSs for volumes
Conclusions: It is necessary to study and QA volume reconstruction algorithm of TPSs before starting an SRS/SBRT program. Specific tests for small volumes below 1 cm³ have to be made and developed.

EP-1456
On the dosimetric impact of virtual material assignment to the ArcCHECK phantom for quality control with Acuros XB
M. Edouard¹, C. Legrand², D. Autret²
¹Institut Gustave Roussy, Medical Physics, Villejuif, France
²Institut de Cancérologie de l’Ouest, Medical Physics, Angers, France

Purpose/Objective: Acuros XB® is a recent advanced algorithm for photon dose calculation. Similarly to Monte Carlo simulations, AXB calculates doses using proper media cross section. The aim of this study was to investigate AXB capacity to correctly account for a virtual material assignment for patient QA in ArcCHECK® diode array (AK).

Materials and Methods: Relative differences were estimated between calculations and measurements in function of the virtual material assigned to the AK. The following virtual materials were studied by scaling CT number to reach AK relative electron density or mass density: human tissues obtained by default on the phantom CT scan, physical material and water. In addition, Anisotropic Analytical Algorithm (AAA) and AXB results were compared. Parametric studies were done in isocentric conditions by varying scatter conditions. Prostate and endometrial patient treatment cases were studied in the AK using ionization chamber (IC), Gafchromic films and diodes measurements.

Results: Regarding the open field tests, ionization chamber measurements at isocenter have shown relative differences of 1.5±/-0.3% using PMMA and -1.2±/-0.3% using the default material (cartilage) each time in combination with a scaled CT number to the AK's mass density. In the cases of water scaled to mass and relative electron density, results have been higher: -2.8±/-0.4% and -3.4±/-0.5%. Regarding the patient treatment studied cases, the best results for ionization measurements were obtained with AXB using the cartilage (with CT numbers adapted to mass density) and PMMA materials. No significant differences were obtained with diode pass rates. Gafchromic films have given interesting results and showed for prostate cancer treatment plans better dose estimation with PMMA material (figure 1).

Conclusions: Phantom CT numbers have to be adjusted to mass density for advanced algorithms such as AXB and to relative electron density for conventional algorithms such as AAA. Better results are observed if right physical materials are applied to the virtual phantom images (PMMA for the ArcCHECK phantom). This study leads to state that a particular attention should be paid to QA phantom commissioning in the TPS for advanced algorithm such as AXB.

EP-1457
VMAT with Simultaneous Integrated Boost in head-and-neck cancer: a dosimetric study aiming to reduce dysphagia
S. Cilla¹, F. Deodato², G. Macchia², C. Digesù², M. Ferro², V. Picardi¹, M. Nuzzo², V. Valentini², A.G. Morganti²
¹Fondazione di Ricerca e Cura “Giovanni Paolo II” Università del S Cuore, Medical Physics Unit, Campobasso, Italy
²Fondazione di Ricerca e Cura “Giovanni Paolo II” Università del S Cuore, Radiation Oncology Unit, Campobasso, Italy
³Policlínico “A. Gemelli” Università del S Cuore, Radiation Oncology Unit, Roma, Italy
⁴Policlinico Universitario “S. Orsola-Malpighi”, Radiation Oncology Department, Bologna, Italy

Purpose/Objective: Dysphagia is one of the most disabling complications associated with head-neck chemo-radiotherapy intensification. Pharyngeal constrictor muscles (PCM) and supraglottic larynx (SGL) have been identified as principal organs in which swallowing dysfunction after chemo-radiation causes dysphagia. If significant correlations between dysphagia and increased doses to PCM and SGL are now established, dose sparing of swallowing structures still represents a major challenge in HN planning optimization process. In this study, we explored the potential of VMAT technique to reduce the risk on swallowing problems after curative chemo-radiotherapy.