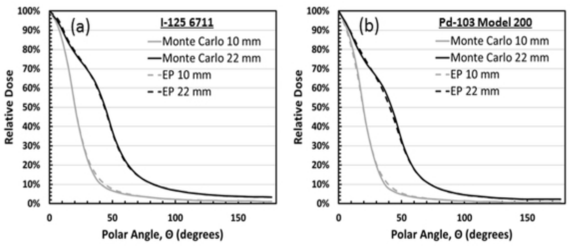
that introduce 15%-30% dose differences compared with all-water dosimetry. A TG43 dose rate calculation method is presented that includes silastic and Modulay heterogeneous effects, uses the actual plaque seed configuration, is not restricted to a particular commercial treatment planning system, and does not require purchase of additional software.

Materials and Methods: Dose rate is calculated using TG43 formalism: $Dose_{EP}(r, \theta) = S_k\Lambda[G_L(r,\theta)/G_L(r0,\theta 0)]g_{EP}(r)F_{EP}(r,\theta)$, with revised radial dose, $g_{EP}(r)$, and anisotropy, $F_{EP}(r,\theta)$, functions specific to I-125 or Pd-103 seeds in COMS eye plaques. EP signifies that the functions are specific to COMS eye plaques. $g_{EP}(r)$, is obtained from Monte Carlo data for eye plaques that contain just a single center seed. $F_{EP}(r,\theta)$ is obtained by performing a Nelder-Mead Simplex routine to find a least squares solution that minimizes differences between Monte Carlo dose rate and $Dose_{EP}(r, \theta)$. Figure: EP method calculation accuracy over the inner sclera surface for 10 mm and 22 mm COMS eye plaques. Dose rate for each curve is normalized to the value at central axis.



Results: TG43 formalism calculations agree with Monte Carlo results, for 10 mm though 22 mm I-125 and Pd-103 eye plaques, to within 2% along and near the plaque central axis and within 4% in the penumbra region for depths ≥ 1 mm. Methods and data for calculating dose rate for COMS plaques with seed model other than I-125 Model 6711 and Pd-103 Model 200 are provided. Since actual seed configurations are used in dose rate calculations, this formalism may also be used to estimate dosimetry for non-standard seed loadings.

Conclusions: This manuscript enables the clinical user to perform accurate heterogeneity-corrected dose rate calculations for COMS eye plaques using TG43 formalism in a spreadsheet or commercial treatment planning system that has a TG43 line source geometry function calculation capabilities.

PO-0850

MRI-Linac: Effect of the magnetic field on the interaction cross sections

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Purpose/Objective: The quality of radiotherapy treatment can be increased by visualising the tumour volume during irradiation. This is achieved by means of an MRI-Linac, which combines patient irradiation and real-time treatment guidance with excellent soft-tissue contrast. Within an EMRP Joint Research Project [1], we are currently investigating whether interaction cross sections used in Monte Carlo codes for the simulation of low-energy secondary electron transport require modification owing to the presence of a magnetic field. For this purpose, the calculated differential cross sections (DCS) for electron scattering with and without magnetic field were compared.

Materials and Methods: Since water molecules are diamagnetic, they can be expected to partially orient themselves under the influence of an external magnetic field. This is because the overall energy of the water molecules depends on the relative orientation of the molecule with respect to the magnetic field. The orientation of a single water molecule was defined using the Euler angles (α,β,γ), which describe a sequence of rotations around two perpendicular axes. A data set of DCS for elastic scattering and ionisation was computed for various values of the Euler angles from 0° to 360° and incident energies varying between 50 eV and 1 keV. The influence of an external magnetic field was then taken into account by determining the resulting distribution of the fractional number of molecules having a certain orientation. This distribution was used together with the aforementioned data set in order to calculate the mean values of the DCS in presence of a magnetic field.

Results: The values of the mean DCS in presence of magnetic field were compared to those with zero field. For 1.5 T, only minor discrepancies of about 7 $\times 10^{-8}$ and 1×10^{-9} were found for elastic scattering and ionisation respectively.

Conclusions: The results show no significant influence of the magnetic field in the range corresponding to MRI-linac devices. Consequently, no changes are necessary in the DCS data used by Monte Carlo simulation codes for dose calculation.

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PO-0851

Skin dose study in chest wall tomohelical treatments with gafchromic® EBT film

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Purpose/Objective: In many cases treatments to the chest wall require complete skin coverage, specifically for patients with stage pT4 disease or with infiltrating carcinoma. Helical Tomotherapy makes it possible to create treatment plans that deliver higher doses to the skin in comparison with other treatments (3D and fixed-gantry IMRT treatments), even without the use of bolus. This work aimed to evaluate, by means of Gafchromic EBT3 films (ISP® Corporation), the skin dose given to patients with chest wall carcinoma undergoing adjuvant tomohelical treatments with and without bolus and also using a virtual bolus, which makes it possible to compensate a potential under-coverage due to breathing motion.

Materials and Methods: The study was conducted on a Tomotherapy Hi-Art® System (Accuray®, Sunnyvale, CA). First of all, standard treatment plans (2Gy/fr) were optimized using the TomoTherapy TPS (Version 4.2.2) and delivered to an anthropomorphic phantom (RANDO® Phantom), which had previously been scanned (slice thickness; 2.5cm). The skin dose was measured using EBT films (read with an Epson Expression Scanner 10000 XL and processed with the FilmQAPro™ application considering the average dose in a ROI) and then compared with the TPS-calculated average dose in a 3mm thick superficial VOI. The plans with virtual bolus were optimized by extending the original PTVs outside the body by 5 mm. Two scenarios were considered: in the first case a unit density override was applied to the PTV, while in the second one the original density was considered. The following comparisons were performed: measured and TPS-calculated dose with/without bolus and virtual bolus; measured dose with/without bolus.

Results: The mean difference (mean% ± SD%) between measured and TPS-calculated dose, in the cases with/without bolus, was 16.0% ± 8.0% and 35.7% ± 6.2% respectively. In the case of virtual bolus it was 42.4% ± 5.7% (density override; 1) and 24.6% ± 7.9% (original density). The mean difference (mean% ± SD%) between bolus and no bolus measured dose was 15.9% ± 5.4% ($p<0.05$; t-Student test).

Conclusions: Although the superficial dose is higher with tomohelical treatments than with 3D and fixed-gantry IMRT treatments, tissue equivalent bolus should be used if the prescribed dose is required to the skin. A better coverage of the target may also be obtained using virtual bolus by extending the PTV outside the skin, in order to consider breathing motion. These preliminary results show that the TPS overestimates dose in the build-up region because of the inaccuracy of the calculation algorithm in the superficial millimeters of skin. Gafchromic EBT3 films are adequate instruments for future *'in vivo'* skin dose measurements in patients with pT4 or infiltrating chest wall carcinoma, as the TPS does not give accurate dose values at the surface

PO-0852

Small field commissioning: should dosimetric correction factors be applied?

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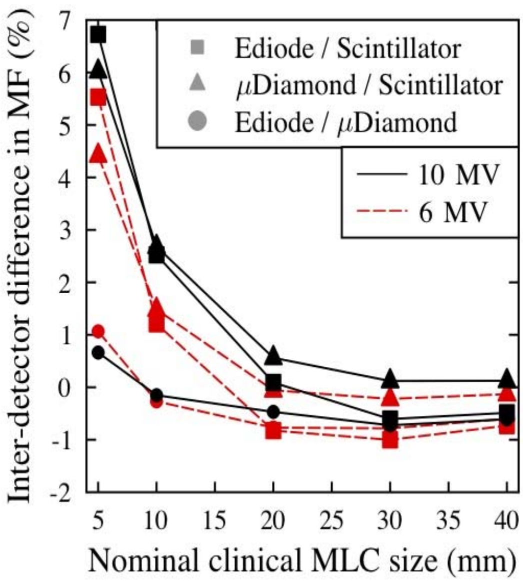
Purpose/Objective: In order to configure and test a new treatment planning system (TPS), clinical physicists are often required to obtain dosimetric datasets for small radiation fields. During the commissioning process, data entered within a TPS should describe the unperturbed dose distribution in water as accurately as possible. However, as lateral electronic equilibrium breaks down, so does the ability of a detector with non-unit density to provide a good surrogate for water dose. The research community has investigated this issue via the calculation of correction factors to account for perturbations introduced by dosimeters within small fields. However, the practicability of correction factors within clinical commissioning is yet to be clarified. This experimental work investigates the magnitude and potential impact of correction factors relevant to linac commissioning.

Materials and Methods: We commissioned two different treatment planning systems – Varian's Eclipse and BrainLab's iPlan – for a Novalis TrueBeam STX with four beam energies: 6FFF, 6MV, 10FFF and 10MV. For fields defined by both jaws and MLCs (side-lengths ≥ 5mm) we measured datasets using three detectors: PTW electron diode 60017 (Ediode), PTW microDiamond 60019 (μDiamond) and Standard Imaging Scintillator W1. Ashland EBT3 film was used as an experimental gold-standard to calculate correction factors for the three detectors.

Results: The scintillator was found to be the best performing detector: its on-axis EBT3 correction factors were approximately unity for all field sizes and beam energies. This result enabled us to use the scintillator as an alternative gold standard, reducing experiment time compared to EBT3. Good agreement was obtained between the μDiamond and Ediode, but both read high relative to the scintillator and EBT3. Additionally, for the Ediode a dose-rate dependence was observed and its known over-response to low energy scatter within large fields was found to be enhanced for 6FFF beams relative to 6MV. For the Ediode and μDiamond small to large field measurement factor (MF) perturbations are plotted in the figure. For a 10mm field the μDiamond introduces output factor errors of ~1.5% for 6 MV beams and 2.5% for 10 MV.



Conclusions: No correction factors are required if the W1 Scintillator is used to measure small field commissioning data. However, this instrument has not yet been fully integrated with a scanning water tank, limiting its utility for profile and PDD measurement. For centres without access to a W1, the μDiamond is recommended over the Ediode. Obtaining correction factors using EBT3 is a time-consuming and difficult task. At 6 MV and 10 MV the uncorrected μDiamond will give results accurate to within 2% for MLC-defined field sizes above ~10mm and ~15mm respectively, such that correction factors may not be required. However, if smaller fields are to be utilised or greater accuracy is required then correction factors should be applied.