AbstractID: 4734 Title: Application of the Quality Index methodology for dosimetric verification of build-up effect beyond air-tissue interface in Treatment Planning System algorithms

Purpose: We have developed and applied a methodology based on quality index (QI) to assess the accuracy of calculations performed on a number of commercial treatment planning systems (TPS) for the case of build-up effect beyond air-tissue interfaces. This methodology requires the preliminary constitution of a "reference data set", obtained experimentally, where correction factors (CF) were calculated as the ratios of the ionization at a depth d beyond the air-tissue interface to the ionization at the same geometrical point for the reference configuration and for the same number of monitor units.

Material and Methods: CFs were obtained from measurements in a phantom that consisted of polystyrene slabs with a 10 cm air-gap between them. Measurements were performed with a plane parallel ionization chamber at different depths beyond the distal air-polystyrene interface. They have been repeated with and without the air-gap at constant source-detector distance, for a 5x5 cm^2 field and for photon energies ranging from 4MV to 23MV and the respective Monte Carlo calculations have been performed the same phantom set-up.

Results: A number of commercial TPS algorithms were tested: users computed CF using basic beam data from their accelerators and these were compared to reference CF for the corresponding QI. Considering that the error in the determination of CF for all beam energies tested should not exceed 6%, at the tested depths only one algorithm calculated CF within this error. The rest of the algorithms overestimated or underestimated CF in the build-up region. At depth where electronic equilibrium is achieved, results were acceptable for all algorithms.

Conclusions: A test that can be easily performed has been designed to validate the calculation algorithm of a TPS for the build-up effect, using the QI of the incident beam.