AbstractID: 4344 Title: First Macro Monte Carlo based commercial dose calculation module for electron beam treatment planning - new issues for clinical consideration

Purpose: To present our experience of commissioning, testing and use of the first commercial Macro Monte Carlo based dose calculation algorithm for electron beam treatment planning. To investigate new issues regarding dose reporting (dose-to-water vs. dose-to-medium) as well as statistical uncertainties for the calculations arising when Monte Carlo based systems are used in patient dose calculations.

Method and Materials: Phantom images studied were obtained through a CT scanner and DICOM image transfer. The calculated dose distributions and monitor units were validated against measurements with film and ionization chambers in phantoms containing 2D and 3D type low and high density inhomogeneities at different source-to-surface distances. The investigated electron beam energies ranged from 6 to 18 MeV.

Results: Newly required input data for a Monte Carlo based electron beam commissioning are presented. The result of validation shows an excellent agreement between calculated and measured dose distributions in all tested cases . The calculated monitor units were within 2% of measured values except for 6 MeV beam and small cutout fields at extended SSDs (>110 cm). The investigation on the new issues of dose reporting demonstrates the differences up to 4% for lung and 12% for bone when “dose-to-medium” is calculated and reported instead of “dose-to-water” as done in conventional treatment planning systems.

Conclusion: The accuracy of the Monte Carlo calculations is shown to be clinically acceptable even for very complex 3D-type inhomogeneities. As Monte Carlo based treatment planning systems begin to enter clinical practice, new issues, such as dose reporting and statistical variations, may be clinically significant. Therefore it is imperative that a consistent approach to dose reporting is used.

Conflict of Interest: Research sponsored by Varian Medical Systems.