

AbstractID: 5375 Title: Verification of Head Leakage as the Primary Source of Shielded Radiation from a Tomotherapy Unit

Purpose

To investigate the adequacy of an existing 6 MV vault for shielding and to verify that head leakage is the primary source of radiation emanating from a helical tomotherapy unit.

Methods & Materials

Before installation of a helical tomotherapy unit in an existing 6 MV accelerator vault, the vendor provided isodose plot was analyzed. Estimated exposure was calculated by scaling the exposure on the plot, correcting for inverse square, and using a 6 MV TVL for 2.35 g/cm^3 concrete from NCRP 49. Sinograms were generated for a rotational (20 second period) and fixed gantry (0° , 90° , 180° , 270°) to deliver radiation with all leaves closed and opened for a $5 \times 40 \text{ cm}^2$ field size and fixed couch position. At 26 locations the exposure rate was measured at height of isocenter with an ionization chamber.

Results

The maximum exposure occurred when the accelerator was nearest to the measurement point. A maximum exposure rate of 1.75 mR/hr was measured in the accelerator control area behind 30" concrete at a 45° angle relative to the axis of the accelerator and a distance of 5 meters. The lowest exposure rate at the same position occurred when the accelerator was at the farthest distance. Assuming 30 minutes of irradiation time per hour, the maximum exposure would be less than 1750 mR/yr. No significant differences ($\sim 10\text{-}15\%$) between field settings were observed. The calculated values are higher than the measured and loosely agree with the highest measured values at each position.

Conclusions

The existing vault is adequately shielded for the tomotherapy unit. Data indicate that leakage is the primary radiation source. Modulation does not affect the leakage significantly. The calculated and measured values disagree and discrepancy may be attributed to the use of a 6 MV TVL.