

AbstractID: 14231 Title: Simplified method for acquiring CTN to RLSP conversion function

Purpose: A major uncertainty that affects the margins in light ion beam planning is the conversion of x ray computed tomography numbers (XCTNs) to relative linear stopping powers (RLSPs). Determination of this conversion function has been difficult in the past because of several reasons. This work developed a simplified method of determining this function.

Method and Materials: The new method was based on the premise that all scanners have their XCTNs for air and water calibrated daily. The XCTNs for high density / high atomic number materials are variable, however, for different scanning conditions. On the other hand, most previous conversion functions have been linear above an XCTN/RLSP of 1050/1.05. A function can therefore be established using a phantom consisting only of water and a single high density / high atomic number material. XCTNs and RLSPs were calculated for various tissues and aluminum 6061 alloy for various effective x ray energies and compared to literature values. A parameter derived from the scaled XCTN (SXCTN) of aluminum was determined that defines the slope of the function for different scanning conditions. A phantom was constructed and used to test the new method with different scanners at a variety of kV_ps.

Results: The RLSP for an SXCTN of 4095 is given by:

$$RLSP_{4095} = 16.616 - (1.0323 \times 10^{-2} * SXCTN_{Al}) + (2.5181 \times 10^{-6} * SXCTN_{Al}^2) - (2.1339 \times 10^{-10} * SXCTN_{Al}^3)$$

For soft tissues, the RLSPs calculated using the aluminum calibration method were between 0 and $\pm 1.5\%$ of the values determined by different investigators on different scanners using traditional methods; deviations as great as 2.6% were found for hard bone. Due to difficulties with previous methods, it is not clear which values are most appropriate.

Conclusion: The new method greatly simplifies acquisition of the conversion function, reduces ambiguity, maintains accuracy, and could promote standardization between facilities.