

AbstractID: 11446 Title: Gypsum barrier shielding estimates for two cone-beam CT systems dedicated to head imaging

Purpose: Cone-beam CT is becoming increasingly popular for bone imaging of the head. Shielding practices for CT defined in NCRP Report No. 147 do not directly apply to a cone-beam system, but standard methods for radiographic systems are also inadequate for the highly filtered x-ray beams in cone-beam CT systems. This study evaluates the use of published 120kVp CT transmission curves for gypsum [Simpkin 1990] to estimate required shielding for two cone-beam CT systems at different energies in comparison to measured transmission data.

Method and Materials: The head CTDI phantom was used with an E-Woo Technologies Master3DS dental CT at 90kVp and a Xoran Technologies MiniCAT at 120kVp to produce scattered radiation. Transmission of scattered radiation through two 3-foot by 3-foot sheets of standard 5/8-inch (16mm) gypsum wallboard was measured with an 1800 cc ionization chamber.

Results: For the Master3DS, transmission through 2 layers (32mm) of gypsum wallboard was 0.30. The estimated shielding from the 120kVp transmission curves for a 1968 mAs/week workload and 2 mR/week permitted exposure at 2.09m distance was 32mm gypsum. The corresponding exposure determined with the measured transmission was 1.3 mR/week, indicating a calculated shielding over-estimate of 22mm of gypsum. For the MiniCAT, transmission through 32mm of gypsum wallboard was 0.51. The estimated shielding from the 120kVp transmission curves for a 960 mAs/week workload and 2 mR/week permitted exposure at 1.46m distance was 32mm gypsum. The corresponding exposure determined with the measured transmission was 2.2 mR/week, indicating a calculated shielding under-estimate of 4 mm gypsum.

Conclusion: The transmission curve data for gypsum at 120kVp overestimates the shielding requirement for this 90kVp cone-beam system, but slightly underestimates the shielding requirement for the 120kVp system. However, since lead is more likely to be necessary to shield the 120kVp system, a minor underestimate for gypsum may be insignificant.