

An efficient method of measuring output factor for the 4 mm-helmet of the Gamma Knife

Output factor measurements for the 4 mm-helmet of the Gamma Knife is difficult because of the short SSD, the small field size, and the sharp dose gradient at the beam focus. We have developed a fast and efficient method of measuring the output factor for the 4 mm-helmet using regular radiographic films. The output factor was measured by exposing single Kodak XV film in the standard Leksell spherical phantom using the 18 mm-helmet whose 30-40 plug collimators were replaced by the 4-mm plug collimators. The output factor for the 4 mm-helmet was measured to be 0.876 ± 0.009 , which is in excellent agreement with our EGS4 Monte Carlo simulated value of 0.876 ± 0.005 . This value also agrees within 2% of more tedious diode and radiochromic film measurements, which require separate output measurements of the 18-mm helmet and the 4-mm helmet. The obtained output factor was 0.884 ± 0.016 for the diode measurement and 0.870 ± 0.018 for the radiochromic film measurement. Since we used single exposure measurement instead of double exposure measurement in our method, systematic errors due to setup variations are canceled out. Therefore, the accuracy of the measurement is improved under our approach. In conclusion, we have developed an efficient method for accurate measurement and quality assurance of the output factor for the 4 mm-helmet of the Gamma Knife.