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A Study of Calibration Methods for Plane-Parallel Chamber

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INTRODUCTION

All national and international dosimetry protocols recommend the use of plane-parallel ionizati on chambers for low energy electron beams. The AAPM TG 39[1] and IAEA TRS 381[2] proto cols have proposed three different methods of calibrating plane-parallel chambers by a direct c omparison with a calibrated cylindrical chamber. They are 1) calibration with a high-energy electron beam in phantom 2) in-phantom calibration in a ^{60}Co beam 3) in-air calibration in a ^{60}Co beam.

The purpose of this work is to evaluate the consistency of determining N^{PP}_{gas} and N^{PP}_{D} by usi ng three methods, respectively.

MATERIALS and METHODS

Depth-ionization measurements for the electron beams of nominal energies 6, 9, 12, 15, 18, a nd 21 MeV from Siemens accelerator(KD2) with a 10x10 cm^2 field size were made using a r adiation field analyzer with 0.125 cc ion chamber. The plane-parallel chamber considered wa s PTW-Markus and the comparisons were made against a calibrated PTW cylindrical Farmer-t ype chamber 30001. The phantom material used for the electron beam and ^{60}Co in-phantom method was solid water(RW3). For the electron beam method, the nominal energies used were 18 MeV and 21 MeV. Acrylic buildup of thickness 0.5 g/cm^2 was used for the ^{60}Co in-air method. For each method, N^{PP}_{gas} and N^{PP}_{D} were obtained for plane-parallel chamber as propos ed by the AAPM TG 39 and IAEA TRS 381 protocols. With N^{PP}_{gas} and N^{PP}_{D}, the absorbed doses were measured along the central axis of the distance of 100 cm(SSD=100 cm) with 10 x10 cm^2 at the depth of maximum for each electron beam, respectively.

RESULTS

The N^{PP}_{gas} and N^{PP}_{D} values by using the three independent methods were calculated as suggest ed by the AAPM TG 39 and IAEA TRS 381 protocols, respectively. The N^{PP}_{gas} values by the three independent calibration methods agreed to within ±0.6%. Similar results were obtained for N^{PP}_{D}. Taking the ratio of N^{PP}_{gas} and N^{PP}_{D} for the three independent methods, they were in agreement within 0.7%.

CONCLUSIONS

The results demonstrate that the values of N^{pp}_{gas} by the three independent calibration methods agree to within ±0.6%. This means that any of the methods will give a fairly good value. Similar results are obtained for the values of N^{pp}_{D}. By comparing 18 MeV and 21 Mev electr on beam methods, 21 MeV electron beam method for both N^{pp}_{gas} and N^{pp}_{D} seems to be better agreement. The ratios of N^{pp}_{gas} and N^{pp}_{D} for the three independent methods are in agreement within 0.7%.