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## COMPARISON OF THE REFERENCE DOSIMETRY ACCORDING TG-21 PROTOCOL AMONG SOLID PHANTOMS

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**Purpose** : To verify the accuracy of the clinical reference dosimetry according to the TG-21 protocol using seven solid phantoms for high energy photon and electron beams.

**Materials and Methods** : The TG-21 protocol was published in 1983, and then the clinical reference dosimetry can be performed in the solid phantom materials. However, only acrylic and clear polystyrene are supported in TG-21. Reference dosimetry followed by TG-21 but use solid phantoms other than the phantoms supported by this protocol can result uncertainties in absolute dose calibration. Plastic Water® Phantom Material (PSW), Standard Grade Solid Water® (GSW), Virtual Water™ Phantom Materials (VSW), RW3 solid water phantom (RW3), white polystyrene phantom (Wpoly), acrylic phantom (Acry) and clear polystyrene phantom (Cpoly) are enrolled to compare the responses with water for 6, 10 and 15 MV photon beams and 6, 9, 12 and 15 MeV electron beams. For the RW3 and Wpoly, we compare the results using the water and clear polystyrene parameters for clinical absolute dosimetry calculation. Ionization measurements were taken at water equivalent depths of 5 cm and  $d_{\max}$  for photon and electron beams, respectively. The phantom dose conversion factor (PDCF)

of the absolute dose between solid water phantoms and water at the identical calibration conditions are obtained. Additionally, comparisons for percent depth doses at water equivalent depths of 5, 10, and 15 cm in photon beams, and  $d_{50}$  and  $d_{80}$  in electron beams were performed to verify the different response at different depths.

**Results :** The variations between five solid water phantoms and water for photon beams are all within 1.0%. For PSW and Acry, the variations in electron beams are within 1.0%. However, the variations are -0.6 to -3.6% for 6 to 15 MeV electron beams for GSW, VSW, RW3, Wploy and Cpoly. The PDCF of 0.994~ 0.964 for electron beams are obtained. The variations of PDD (5 cm), PDD (10 cm), PDD (15 cm) between five solid water phantoms and water for photon beams are within 1.1%. The variations of  $d_{50}$  and  $d_{80}$  between five solid water phantoms and water for photon beams are within 1.5 mm.

**Conclusion :** The PSW、GSW、VSW、RW3、Wpoly solid water phantom can be treated as water for 6, 10 and 15 MV photon beams. And the PSW can also be treated as water for electron beams. For electron beam dose calibration, PDCF should be applied for GSW, VSW, RW3 and Wpoly. Phantom response relative to water should be evaluated carefully when TG-21 protocol is used for clinical dose calibration.

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Key words: TG-21 protocol, Solid water phantom, Phantom dose conversion factor

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