The use of tissue-air ratio with high energy photon fields

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Conventional dosimetry for photon beams below 5 MV uses tissue-air ratio (TAR). This present work shows that the conventional objections to the use of TAR-based dosimetry for higher-energy beams, including the inability to measure in-air dose, failure of lateral electronic equilibrium in the build-up cap for small fields, and Compton scatter from the build-up cap contributing to the in-air dose, all can be overcome. In addition, this work describes minor modifications of commercial scanning systems to measure TAR directly. This dissertation shows that a tissue-maximum ratio system propagates errors or degenerate into the TAR system. As with lower energy radio-therapy beams, TAR forms the dosimetery system of choice for higher energy beams. While this work shows that the tissue-air ratio proves sufficient for all simple dose calculations without the need for scatter-air ratios, for complex situations a differential tissue-air ratio has been derived to describe the dose contribution from one volume element to another.