Purpose: This phantom study investigated variations of mucosal dose on photon beam energy, beam angle, multi-beam configuration and mucosal thickness, when using small photon fields in head-and-neck radiotherapy.

Methods: Cylindrical mucosa phantoms with bone and air heterogeneities were created with mucosal thickness (normal tissue) equal to 1, 2 and 3 mm. For dosimetric comparison, corresponding homogeneous phantom with all heterogeneities replaced by normal tissue was also used. These phantoms were irradiated by photon beams with field size = 1 cm$^2$. Beam energies of 6 and 18 MV were used with beam angles varied to 0°, 90° and 180°. Moreover, multi-beam configurations of 2, 4 and 8 beams were used, and doses along the central-beam axis in the mucosal tissue were calculated using Monte Carlo simulations (EGSnrc code).

Results: For beam angle equal to 0°, the mucosal surface doses decreased slightly with an increase of the mucosal thickness (1–3 mm), while the surface dose of the 6 MV photon beam was decreased more significantly than the 18 MV. For beam angle equal to 180°, variation of mucosal surface dose with its thickness was found insignificant. For different multi-beam configurations, it was found that the variation of mucosal dose on its thickness became insignificant when the number of photon beams around the mucosa was increased. In addition, the change of mucosal dose due to the bone and air heterogeneities depended on the photon beam energy, beam angle and mucosal thickness.

Conclusions: It is concluded that mucosal dose depends on variations of beam energy, beam angle, multi-beam configuration and mucosal thickness for small photon fields. The dosimetric information in this study should be considered in studying the mucosal complications in head-and-neck IMRT, so that an optimized treatment strategy to minimize mucosal complications can be developed.

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