Variation of mucosal dose in head-and-neck radiotherapy: A phantom study using Monte Carlo simulation

Innovation/Impact: This study provided important information in studying the mucosal dose in head-and-neck IMRT (small segmental photon beams), so that optimized treatment strategy can be developed to minimize the mucosal complications.

Methods: Homogeneous (normal tissue only) and heterogeneous (normal tissue, bone and air) cylindrical mucosa phantoms (Fig. 1) were irradiated by small photon beam (1 x 1 cm²) with different energies (6 and 18 MV), beam angles (0°, 90° and 180°) and beam configurations (2, 4 and 8 beams). Monte Carlo simulation (EGSnrc code) was used to calculate doses along the central-beam axis (vertical broken line in Fig. 1) in the mucosal tissue (inner orange ring).

Results: Fig. 2: For 6 MV photon beam with 0° gantry angle, mucosal surface dose (i.e. dose at 0 mm depth) decreases with an increase of mucosal thickness. This reflects that mucosal complication may become more serious due to higher dose deposition, when the mucosal layer becomes thinner in the radiation treatment.

Figs. 3 and 4: Comparing the 2-beam (0° and 180°) and 8-beam (0°, 45°, 90°, 135°, 180°, 225°, 270° and 315°) configuration, it is found that the dependence of the mucosal dose on its thickness became insignificant when the number of photon beams around the mucosal tissue was increased.

Conclusions: It is concluded that the mucosal dose with bone varied with the beam energy, beam angle, multi-beam configuration and mucosal thickness for small segmental photon beam.