Purpose:
The purpose of the study is to investigate the re-buildup after air cavity of various thicknesses for 6MV therapeutic photon beams with different field sizes.
Methods:
The BEAMnrc code was chosen for Monte Carlo (MC) dose simulation. Complete simulation includes all geometry and components of the treatment head of our Varian 21EX linear accelerator and beam propagation within the water phantom. 6 MV photon beams with field sizes at 3x3 and 10x10 cm2 were studied. Air cavities with thickness 1 and 5 cm were inserted at 4 cm depth. The simulated re-buildup dose distribution was compared to both those from ultra-thin TLD measurement (Rexon TLD-100H, 4.5mm x 0.1mm) and treatment planning calculation (Eclipse, Varian Medical Systems, Palo Alto, CA) using the AAA algorithm.

Results:
According to the MC simulation results, dose reductions at the re-buildup surface for 10x10 cm2 fields are 4.6% and 20.5% for 1 and 5 cm air cavities, respectively. Those for the 3x3 cm2 fields are 29.0% and 77.7% for 1 and 5 cm air cavities, respectively. The differences between TLD measurement and MC simulation are within the detector uncertainty. The results indicate that the treatment planning calculation shows minimum ability to model the re-buildup phenomenon.
Conclusions:
Dose re-buildup near an air cavity is a possible cause of target underdose. Results from the current study indicate that it is more profound for large cavity thicknesses and small irradiation fields. Ultra-thin TLD was also proven an effective detector for measuring dose distribution near re-buildup region.