Purpose: Breast cancer patients who undergo a mastectomy often require post-mastectomy radiation therapy (PMRT) due to high risk disease characteristics. PMRT usually accompanies scar boost irradiation (10-16Gy in 5-8 fractions) using en face electrons, which often results in increased dose to the underlying lungs, thereby potentially increasing the risk of radiation pneumonitis. Hence, this study evaluated water-equivalent phantoms as energy degraders and as an alternative to a bolus to reduce radiation dose to the underlying lungs for electron scar boost irradiation.

Methods: Percent depth dose (PDD) profiles of 6 MeV (the lowest electron energy available in most clinics) were obtained without and with commercial solid water phantoms (1 to 5mm by 1mm increments) placed on top of electron cones. Phantom attenuation was measured by taking a ratio of outputs with to without the phantoms in 10x10cm² cone size for monitor unit (MU) calculation. In addition, scatter dose to contralateral breast was measured on a human-like phantom using two selected scar (short and long) boost patient setups.

Results: The PDD plots showed that the solid water phantoms and the bolus had similar dosimetric effects for the same thickness. Lower skin dose (up to 3%) to ipsilateral breast was observed with a 5mm phantom compared with a 5mm bolus (up to 10%) for all electron cones. Phantom attenuation was increased by 50% with about a 4.5mm phantom. Also, the energy degraders caused scatter dose to contralateral breast by a factor of 3 with a 5mm phantom.

Conclusion: Our results demonstrate the feasibility of using water-equivalent phantoms to reduce lung dose using en face electrons in patients with a thin chest wall undergoing PMRT. The disadvantages of this treatment approach (i.e., the increase in MUs and treatment time, and clinically insignificant scatter dose to the contralateral breast given usually 10Gy) are outweighed by its above clinical benefits.