Public Abstract
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The risk of developing stray radiation induced secondary cancers in patients that undergo external beam radiotherapy is a concern; particularly from the secondary neutrons generated during delivery of high energy photon and proton beam radiotherapy. This work investigates the effectiveness of several shielding materials commonly used for neutron shielding, including; high density concretes, regular density concretes, stainless steel, and borated polyethylene. High density concretes were found to be more suitable for space-restricted environments. High concentrations of hydrogenous materials are ideal for absorbing photon derives neutrons and iron for proton derives neutrons.

This work studies the neutron productions around two models of electron linear accelerators used for delivering 10MV and 18MV photon beams, using measurements. It was found that ambient neutron dose equivalents from the Elekta linear accelerator (Elekta Inc, GA) were significant lower than the Varian linear accelerator (Varian Medical Systems, CA), especially for 18MV beams.

Neutron productions around the first compact proton accelerator, the MEVION S250 Proton Therapy System (MEVION medical systems, MA), are also evaluated using both measurements and Monte Carlo simulation methods. The MEVION S250 proton accelerator is a passive scattering proton accelerator which utilizes a superconducting magnet synchrocyclotron. It was found that the neutron dose equivalents per therapeutic dose decreased as increased of 1) the aperture field sizes, and 2) the distances between the evaluated locations and the isocenter. The neutron productions from the MEVION S250 proton accelerator were found to be comparable with other existing passive scattering systems.