Purpose: Rapid developments in laser technology have facilitated proton (light ion) acceleration using laser-induced plasmas. In this work, we investigate an experimental system for laser-accelerated proton therapy.

Method and Materials: Our system consists of a commercial 150 TW laser, custom-made laser-pulse compression and target chambers, particle selection and beam collimating devices, dosimetry monitoring systems and shielding constructions. We have performed initial laser-proton acceleration experiments with thin aluminum foils as target materials. The maximum proton energy was measured using CR-39 film and a Thomson parabola ion analyzer. We have performed particle-in-cell simulations to investigate the optimal laser parameters and target configurations to facilitate laser-proton acceleration and dosimetric studies.

Results: The primary particles resulting from the laser-target interaction are protons and electrons. Our particle in cell simulation predicted protons of up to 300 MeV and electrons of 20 MeV for a laser intensity of 10^{21} W/cm^2. The maximum number was 10^{11} and 10^{12} per pulse for protons and electron, respectively. Our initial testing with a 10^{18} W/cm^2 laser intensity (at 10 TW) produced up to 1 MeV protons with a broad energy spectrum.

Conclusion: We have developed an experimental laser-proton accelerator for radiation therapy applications. Initial experimental studies have demonstrated proton acceleration at low laser power levels. Further studies with laser intensities up to 2 x 10^{20} W/cm^2 are being conducted with different target materials and configurations.