

AbstractID: 10261 Title: Determining changes to tissues irradiated during proton treatment delivery by measuring secondary prompt gamma-ray spectra

**Purpose:** Recent studies have investigated the use of secondary 'prompt' gamma-rays emitted from patients during proton therapy as a possible method to verify dose delivery. The purpose of this study was to determine if the prompt gamma-ray spectra emitted from biological tissues could be used as a method to analyze changes to tissues irradiated during proton treatment delivery.

**Method and Materials:** We performed measurements and Monte Carlo calculations of the prompt gamma emission spectra from tissue equivalent phantoms and tissue targets. The emission spectra from several types of tissue were characterized according to the emission lines from the individual elemental constituents of the target tissue. Next, we studied the individual emission lines from the tissue targets as a function of elemental concentration and density.

**Results:** These results show that the prompt gamma emission lines from the major elemental components can be identified in the measured and calculated spectra. The intensities of these emission lines were found to be a function of concentration of each element and the physical density of the tissue.

**Conclusion:** Based on the results of these preliminary studies, we conclude that it may be possible to determine both the atomic composition and physical density of irradiated tissues by measuring the prompt gamma ray spectra emitted during proton treatment delivery. Development of a technique to measure prompt emission spectra during daily treatment delivery would allow for the direct measurement of changes to irradiated tissues, such as changes to tumor hypoxia or tissue densities over the course of proton treatment delivery.