

AbstractID: 7122 Title: Measurement of Delays Between Gating Signals and Beam-On for Imaging, Static and Dynamic Treatments

Purpose:

To determine the delays between gating signals and delivery of kV imaging and MV treatment beams for static, enhanced dynamic wedge, and IMRT treatments.

Method and Materials:

All measurements were taken on a linear accelerator (Trilogy, Varian Medical Systems, Palo Alto, CA), equipped with kV imaging and respiratory gating. A phantom simulating regular motion was used to trigger the gating system. Delivery of both kV imaging and MV treatment beams were monitored using a diode connected to an analog electrometer operating in current mode. The electrometer's voltage output and the gating signal were both monitored by a multichannel oscilloscope. Traces were recorded comparing the diode output to the gate signal. The MV beam was monitored during delivery of static, enhanced dynamic wedge and IMRT fields. For the IMRT field the diode received only scattered radiation resulting in poor signal-to-noise but the results were still sufficient for this work.

Results:

The delay between the gating signal and beam on signal was found to be unmeasurable for the static MV beam, and 30 and 50 msec respectively for the wedged and IMRT beams. The delay for the kV beam was 300 msec. Because tumors can move up to 2 cm in a 5 sec breathing cycle, a 300 msec delay can result in up to a 4 mm position error; however, because gating is generally done at expiration or inspiration where the velocity is at a minimum, the uncertainty should be much lower.

Conclusion:

There is no appreciable delay between gating signals and MV irradiation. There is a delay between kV imaging and gating signals but the clinical consequences can be minimized by gating where tumor velocity is minimal.