

A technique was developed for respiration synchronized treatment delivery on a helical tomotherapy system. Breathing synchronization is achieved by modifying the planned MLC delivery sinogram into alternating beam-on and beam-off cycles. A custom program reads every 51 projections (*i.e. one gantry rotation*) from the original sinogram and then inserts 51 new projections with all the MLC leaves closed. The resulting sequence consists of alternating 12-second periods of beam on and off. Because every other gantry rotation is a closed, the treatment pitch must be doubled to maintain the original dose distribution. The timing of the breath-hold and breathing cycle is synchronized with the MLC delivery. During the breath-hold phase, the MLC leaves are producing noise as they “pop” from open to closed. In contrast, there is silence in the treatment room during the free-breathing phase because the MLC leaves are closed. This inherent audio prompting, along with the Varian RPM System allows the patients to synchronize their breathing with the treatment delivery. Calculational comparisons of unmodified deliveries and breathing synchronization deliveries were performed for 5 patient treated with Helical Tomotherapy. The calculated and measured film dosimetry results indicated that the maximum difference between the original and breathing synchronization sequences occurred between the 95 and 105% isodose lines. Based on these results, it is possible to deliver Breathing Synchronization treatments on the tomotherapy HI-ART<sup>2</sup> system by simply modifying the original delivery sinogram to include alternating beam-on and beam-off sequences.

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