AbstractID: 11346 Title: Evaluation of Monte Carlo treatment planning for CyberKnife stereotactic radiosurgery/radiotherapy treatments of head and body lesions

**Purpose:** To evaluate Monte Carlo calculated plans for Cyberknife Stereotactic Radiosurgery/Radiotherapy treatments of head and body lesions.

## **Method and Materials:**

The Multiplan is the Cyberknife treatment planning system which recently implemented a Monte Carlo (MC) in addition to the original pencil-beam based Raytrace (RT) algorithm for dose calculations. This study compares DVHs and maximum doses ( $D_{max}$ ) to the lesions and selected critical organs obtained by the two algorithms. Planning is done on CT fused with either MRI or PET image sets as appropriate. A treatment plan is created on the Multiplan 2.1 using the RT with equivalent pathlength inhomogemeity corrections. When an acceptable distribution is obtained, the plan is re-calculated using MC with 1% relative mean standard deviation. The number of beams, beam directions, and monitor units are kept the same. The dose distributions are then compared with respect to maximum doses to target and critical organs, as well as target coverage.

## **Results:**

For lung lesions PTV  $D_{max}$  calculated by the RT are on average larger then the MC doses by up to a factor of 1.63 while  $D_{max}$  to critical structures were up to 4 times greater. For cranial and abdominal targets the differences in maximum doses and tumor coverage were generally less than 2% between the two plans. Larger differences of ~5% are noted for planning for lesions in the nasopharynx in the vicinity of air cavities.

## **Conclusion:**

In lung MC can produce large differences in target and critical organs' dose coverage relative to RT. RT tends to underdose target structures and the effect is more pronounced as the collimator size decreases. Smaller differences are observed in plans for sites where beams traverse mostly homogeneous water-equivalent tissue. Therefore the Monte Carlo algorithm should be consistently used for planning for lesions in lung and near air cavities.