AbstractID: 5888 Title: Intra-fraction motion of immobilized intra-cranial and extra-cranial patients assessed by the CyberKnife image-guidance system

Purpose:
To quantify intra-fraction motion of immobilized intra-cranial and extra-cranial patients. The data can be used to optimise the intra-fraction imaging frequency and consequent patient set-up correction with the CyberKnife image-guidance system and to establish the required margins in the absence of such a system.

Method and Materials:
We analysed the intra-fraction motion of 21 intra-cranial patients, who were immobilized with a thermoplastic mask and 9 supine and 8 prone treated extra-cranial patients, who were immobilized with a vacuum bag. The motion was recorded by the CyberKnife image-guidance system. We analysed the intra-fraction motion by calculating the mean displacement with the standard deviation (SD) as a function of the time between kV X-ray localizations. For the three groups separately, we calculated the systematic (overall mean and SD) and the random displacement as a function of the imaging frequency.

Results:
For all patients, the overall mean displacement was below 0.5 mm (3D vector) over a period of 15 min and hardly increased. The SD of the systematic displacements increased linearly over time for all 3 patient groups. For intra-cranial, supine and prone treated patients, this SD increased to 0.5, 1.2, and 1.6 mm, respectively, in a period of 15 min. The random displacements for the prone treated patients were significantly higher than for the other groups, namely 1.3 mm (1 SD). This was most pronounced in the AP direction, suggesting that the larger intra-fraction motion was caused by respiratory motion.

Conclusions:
Repeated intra-fraction imaging and consequent patient set-up correction with an interval of less than 5 min adequately compensates for patient motion during treatment. In the absence of this procedure, intra-fraction motion has to be accounted for in the PTV margin.