

AbstractID: 7277 Title: Registration of frameless high-field MRI to low-field frame-bearing MRI images in Leksell Gamma-knife radiosurgery

**PURPOSE:** The purpose of this study was to introduce the frameless 3 Tesla MRI images into the LGK planning through normalized mutual-information image registration.

**METHODS and MATERIALS:** Treatment planning at LGK facilities is typically done from relatively low-field MRI images since high-field MRI equipment is rarely available.

Yet, 3 Tesla MRI provides much higher resolution and would be better suited for treatment planning. To provide 3T image quality at LGK facilities, we have registered a frameless 3T MRI on a conventional low-field image taken with the head ring in place.

The registration was done by determining a best transformation matrix with six degrees of freedom through minimizing a cost function according to the simulated annealing algorithm. The properly transformed 3T images were superimposed on the low-field images of the head, while leaving the fiducial markers in place. These 'reframed' 3T MRI images were used like 'standard' MRI images for contouring and treatment planning.

**RESULTS:** For an initial test of this approach, we obtained two conventional CT scans of an in-house built head phantom that was equipped with a total of nine markers (six imbedded and three surface markers). When the second CT scan, which was obtained after the phantom had been rotated and shifted, was registered according to the described procedure, all 9 markers coincided within one or two pixels. In a subsequent clinical test using a 1.5T and a 3T MRI scan, the accuracy of registration was verified by comparing the registered superimposed images on a total of 56 slices. Prominent structures that could be clearly seen on both scans agree within 2-3 pixels. The whole procedure can be done in about 15 minutes.

**CONCLUSIONS:** The proposed method allows the use of frameless 3T MRI images for LGK procedures.