Purpose: To provide a method of accurate, submillimeter image-guidance for the targeting of small brain tumors in an array of 5 mice when irradiating with the Gamma Knife Perfexion treatment unit.

Small-animal models provide a useful platform for studying the effects of radioprotectors and radiosensitizers on normal brain tissue and tumors. Efficient irradiation of an array of up to 5 mice in a single programmed sequence, using the Leksell Gamma Knife Perfexion (GKPfx) treatment unit, is an ongoing technique at our institution. One challenge in the process is to accurately guide the 4-mm-diameter radiation beams' focus of the GKPfx treatment unit to irradiate only a small region of interest (ROI) that includes the hippocampus. This can be accomplished through image guidance using a high-field, high-resolution small-animal MR imager and transforming the ROI image coordinates to Leksell stereotactic treatment coordinates.
Materials and Methods: Uniquely-tagged mice were individually-scanned using a small-animal MR imager. Prior to scanning, each mouse was carefully positioned and immobilized with ear bars and a bite bar using a specially designed mouse holder module, which has three, CT- and MR-viewable, fiducials embedded within it. The fiducials provide a 3-D frame of reference to transform ROI image coordinates to Leksell stereotactic coordinates.
A Matlab script displays the image set, provides a tool to locate fiducials and other ROIs in image coordinates, computes the coordinate system transforms and saves results in an Excel worksheet. Transform computation uses Horn's quaternion-based method.

Results: The previously described method shows accuracy of less than 1.0 mm, when imaging resolution is 0.3 mm in X and Y and 1.0mm in Z. Computation for one mouse holder position takes less than 2 s on 1.8GHz Centrino Duo PC.

Conclusions: This image-guided technique provides for fast and accurate MR/CT localized radiation targeting of mouse brain.