

Purpose:

The stereotactic radiation therapy systems incorporate diagnostic image's for treatment planning, patient localization, alignment, and dose delivery. The system accuracy depends on the accuracy of each subsystem and is difficult to separate. For some applications, such as trigeminal neuralgia, the accuracy is more critical. For example, a 1.5 mm error could result in a 50% error in dose delivery when treating a 3 mm target.

Method and Materials:

We have evaluated the system accuracy of three "knife" radiosurgical systems: Elekta Gamma knife, Accuray Cyberknife and linac based Radionics X-knife. The Gamma knife and X-knife systems are frame based and the Cyberknife is frame less. The total system error is measured directly using an anthropomorphic head phantom containing a spherical target to a maximum dose of approximately 30 Gy. Two orthogonal sheets of radiochromic films provide dose profiles along the principal axes of the phantom through the center of the target. The irradiated films were evaluated by using an Accuray End to End test program and MD Anderson Radiological Physics Center.

Results:

A series of accuracy measurements were performed on Cyberknife in both anatomical and fiducial registration modes. For anatomical registration, the average total error is 0.68 mm with a standard deviation of 0.22mm. For fiducial registration, the average total error is 0.50 mm with a standard deviation of 0.25 mm. The results from Gamma knife are similar to those obtained from Cyberknife. The data from the Gamma knife show an average total error of 0.83 mm and a standard deviation of 0.28 mm. The test from X-knife has a slightly larger total error of 1.0 mm. The total errors include those generated by diagnostic modalities as well as by film dosimetry.

Conclusion:

Our results show that all three systems can deliver a one millimeter targeting accuracy.