In the x-ray phototherapy of brain tumors, the tumor is loaded with iodine and exposed to kilovoltage x-rays. Due to the high photoelectric cross sections of iodine, substantial photoelectric interactions occur. The flux of photoelectrons, characteristic x-rays and Auger electrons produce a localized dose enhancement. A modified CT scanner, CTRx, can be used both for tumor localization and delivery of the dose enhancement therapy. Monte Carlo methods were employed to simulate the treatment of iodinated brain tumors with a CTRx. The calculated results reveal: the effect of tumor iodine concentration on dose distribution, the degree of skull bone sparing with the application of multiple arcs, and the homogeneity of tumor dose distribution versus iodine concentration. A comparison with a 10 MV stereotactic radiosurgery treatment shows the CTRx dose distributions rival or exceed those of conventional treatment modalities.