

Purpose: To quantify the conformity and gradient of stereotactic radiosurgery (SRS) plans planned with helical tomotherapy, and to compare helical tomotherapy SRS plans with conventional linear accelerator (linac) SRS plans.

Methods and Materials: Representative radiosurgery cases were selected from a database of patients treated with conventional linac radiosurgery techniques. Simple and complex radiosurgery planning scenarios were investigated. For each case, hypothetical helical tomotherapy IMRT radiosurgery plans were developed using a HiArt helical tomotherapy unit (Tomotherapy Inc., Madison, WI). The HiArt hypothetical plans were compared to the conventional linear accelerator radiosurgery plans based on dose conformity, dose gradient outside of the target volume, and on dose-volume histogram analysis of adjacent radiosensitive structures.

Results: Helical tomotherapy could theoretically be used to deliver very conformal radiosurgery dose distributions for small (<10 cm³) target volumes while maintain a steep dose gradient outside of the target volume. Helical tomotherapy plans were generated which exceeded the RTOG radiosurgery acceptability criteria (planning isodose to treatment volume ratio < 2.0, maximum dose to peripheral dose ratio < 2.0). Average dose gradients of about 5mm between the prescription and half-prescription isodose shells were readily attainable. In cases with adjacent radiosensitive structures, helical tomotherapy plans provided target coverage and radiosensitive structure sparing comparable to conventional linac SRS plans. Tomotherapy beam-on times were longer than that expected for conventional linac SRS treatment, but still feasible.

Conclusions: Helical tomotherapy radiosurgery plans can compare well with conventional radiosurgery plans in terms of dose conformity and gradient, and in radiosensitive structure sparing. If target localization and treatment delivery issues are addressed, helical tomotherapy units should be capable of satisfactorily delivering radiosurgery treatments.

Conflict of Interest: Two of the authors (KR, GO) are employed by Tomotherapy, Inc.