

Purpose: This work compares all linac-based SRS treatment techniques currently available for single lesion cranial SRS. This study includes the planning comparison of dynamic conformal arc (DCA), static non-coplanar intensity modulated radiotherapy (NCP-IMRT), volumetric modulated arc therapy (RapidArc), robotic radiosurgery (Cyberknife), and helical tomotherapy (HI-ART TomoTherapy) for cranial SRS.

Methods: Thirteen target volumes with range 0.23 to 20.76 cc were retrospectively selected and transferred to a CT scan of a phantom designed for end-to-end SRS QA (Lucy phantom, Standard Imaging). Plans were developed using, iPlan TPS (v4.1, BrainLAB) for DCA (4 arcs) and NCP-IMRT (16 beams), meanwhile the Eclipse TPS (v8.6, Varian Medical Systems) was used for the RapidArc (4 arcs) technique. Multiplan TPS (v3.5, Accuray) and TomoTherapy HI-ART TPS (v3.1.4.23) was used for Cyberknife and TomoTherapy respectively. All plans were evaluated using four criteria, (1) Paddick's Conformity Index (CI), (2) Paddick's Gradient Index (GI), (3) Homogeneity Index and (4) Wagner's Conformity/Gradient Index (CGI).

Results: The average Paddick conformity index, CI was 0.64, 0.72, 0.76, 0.78, and 0.65 for the DCA, NCP-IMRT, RapidArc, Cyberknife and Tomotherapy techniques respectively. The average Paddick gradient index, GI was 3.3, 3.6, 4.2, 4.4, and 4.9 for the DCA, NCP-IMRT, RapidArc, Cyberknife and Tomotherapy techniques respectively. The average Wagner's CGI was 71.6, 74.5, 72.2, 71.37, and 62.18 for the DCA, NCP-IMRT, RapidArc, Cyberknife and Tomotherapy techniques respectively. IMRT-based techniques and robotic radiosurgery showed better CI and CGI, whereas DCA showed the best dose fall off followed by NCP-IMRT.

Conclusions: All methods were able to produce comparable plans for most of the targets tested. More importantly, it is suggested that for future planning studies the plan criteria must be explicit in their goals. In particular, the gradient index should be specified along with the desired dose prescription and conformality.