

Purpose: To determine the maximum proton kinetic energy required to treat a given percentage of patients eligible for stereotactic radiosurgery (SRS) with coplanar arc-based proton therapy, contingent upon the number and location of gantry angles used.

Methods: Treatment plans from 100 consecutive patients treated with SRS at the University of Wisconsin Carbone Cancer Center between June of 2007 and March of 2010 were analyzed. For each target volume within each patient, in-house software was used to place proton pencil beam spots over the distal surface of the target volume from 51 equally spaced gantry angles over 360 degrees. For each beam spot, the radiological pathlength from the surface of the patient to the distal boundary of the target was then calculated along a ray from the gantry location to the location of the beam spot. This data was used to generate a maximum proton energy requirement for each patient as a function of the arc length that would be spanned by the gantry angles used in a given treatment.

Results: If only a single treatment angle is required, 100 percent of the patients included in the study could be treated by a proton beam with a maximum kinetic energy of 118 MeV. As the length of the treatment arc is increased to 90, 180, 270, and 360 degrees, the maximum energy requirement increased to 127, 145, 156, and 179 MeV, respectively.

Conclusions: A large percentage of SRS patients could be treated at relatively low proton energies if the gantry angles used in the treatment plan do not span a large treatment arc. Maximum proton kinetic energy requirements increase linearly with size of the treatment arc. A dedicated proton SRS system could cost much less than existing proton systems due to decreased energy requirements.

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