

Feasibility of Lateral Head Flexion to Improve SRS Plan Quality for Ring Gantry Delivery

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Abstract

Objectives: Ring gantry radiotherapy devices are limited to deliver beams in a single axial plane, severely limiting beam entrance angles and rendering non-coplanar beam delivery impossible. Conversely, a ring gantry geometry greatly simplifies delivery machines and increases the efficiency of treatment with the potential to decrease the overall costs of radiotherapy. This work explores the use of lateral head flexion in order to increase beam entrance angles and extend the available solid angle space for ring gantry stereotactic radiosurgery (SRS). **Methods:** A 1.5T MRI scanner was used to scan seven healthy volunteers at three different head positions: a neutral position, a left lateral flexion position and a right lateral flexion position. The lateral flexion scans were co-registered to the neutral head position scan using rigid registration and extracting the rotational transformation. The head pitch, roll and yaw were computed for each registration to evaluate the natural range of motion for all volunteers. A ring gantry plan geometry was used to generate two sets of single fraction SRS plans (21 Gy/tx) for five datasets: one coplanar set for head neutral scans, and a three arc path set using the head neutral and lateral head flexion scans. The conformity index (CI), gradient measure (GM), R50, and R10 were used to evaluate both sets of plans. **Results:** The average roll, pitch and yaw was $16.9^{\circ} \pm 3.7^{\circ}$, $4.1^{\circ} \pm 4.7^{\circ}$, and $2.54^{\circ} \pm 4.9^{\circ}$ for right lateral flexion and $14.0^{\circ} \pm 3.7^{\circ}$, $4.9^{\circ} \pm 4.3^{\circ}$, and $2.8^{\circ} \pm 5.4^{\circ}$ for left lateral flexion. The CI decreased an average of 8.7% from 1.32 on the head neutral plans to 1.20 on the lateral head flexion plans. The GM decreased 9.2% from 5.3 mm to 4.9 mm, R50 decreased 6.9% from 3.72 to 3.46, and the R10 decreased 29.1% from 62.3 to 44.2. **Conclusion:** Lateral head flexion was shown to increase beam entrance angles considerably improving plan conformity and normal tissue sparing in this pilot study of five sets of plans. Rigid registrations demonstrated each lateral flexion to be analogous to a 15° couch kick. The quality of SRS plans delivered on ring gantry radiotherapy devices may significantly improve with the use of a lateral head flexion setup.

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Abstract

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