

Purpose: This work measures peripheral doses and estimates the risk of secondary fatal malignancies associated with pediatric brain and adult prostate treatments delivered with a Cyberknife and a conventional, gantry-based accelerator.

Materials and Methods: Comparable Cyberknife and IMRT brain treatment plans were developed for a pediatric anthropomorphic Rando phantom using the Cyberknife Multiplan and Phillips Pinnacle treatment planning system, respectively. Similarly, adult prostate treatment plans were generated using the Multiplan and Pinnacle planning systems for an adult Rando phantom. Target and organs at risk were contoured for each phantom and equivalent, clinically appropriate normal tissue constraints were utilized for each treatment modality. TLD were positioned in specific organ locations within each anthropomorphic phantom and were irradiated three times per plan. The average dose was determined for each out-of-field organ site and was compared between the two different treatment delivery devices. Organ weighted, linear non-threshold dose response model risk factors were then used to estimate the risk of secondary fatal malignancies.

Results: Doses calculated from the adult TLD data were equal to or lower for all organs with the IMRT treatment, and hence, the overall risk was lower. The pediatric TLD dose findings were mixed between the IMRT and Cyberknife treatments. TLD located in cranial organ sites, proximal to the treatment field, exhibited higher readings for the IMRT treatment. However, the Cyberknife treatment consistently resulted in higher average doses at all distant organ sites.

Conclusion: The overall risk of secondary fatal malignancies was higher for the Cyberknife compared to the IMRT adult and pediatric treatments, with the exception of critical organs adjacent to the treatment field for the pediatric case. This appears to be due to higher out-of-field secondary radiation doses resulting from the greater number of monitor units and longer treatment times associated with Cyberknife treatments.