AbstractID: 11465 Title: Measurements of Leakage Radiation for Secondary Barrier Shielding Calculations for the CyberKnife® Robotic Radiosurgery System

Purpose: To provide experimental data on the leakage radiation for the CyberKnife® Robotic Radiosurgery System (Accuray Incorporated, Sunnyvale, CA) for more accurate input to secondary barrier shielding calculations. **Method and Materials:** The typical CyberKnife treatment vault design consists of all walls being primary shielding barriers. A site could consider using a vault with secondary barrier walls such as an existing gantry-based LINAC vault. However it may be challenging to calculate the required secondary shielding barrier thickness. As NCRP Report 151 notes in its recommendation, the absence of published leakage radiation data for the CyberKnife leads one to use certain conservative assumptions for secondary barrier calculations. Measurements were made in narrow-beam and broad-beam geometries to characterize the leakage radiation properties of the CyberKnife LINAC and experimentally determine the tenth-value-layers (TVL) for concrete and lead. Given the wide range of LINAC positions and orientations during a CyberKnife treatment, an examination of the hardness of the leakage radiation spectrum vis-a-vis emission angle from the LINAC was also performed. Additionally, a retrospective review of CyberKnife clinical usage was conducted to provide updated shielding workload assumptions. **Results:** The measurements yielded an equilibrium TVL of 5.3 ± 0.2 cm for lead. The experimentally derived value of 29.2 ± 0.4 cm of concrete is 10% less than the value suggested in NCRP Report 151. Furthermore the product specification for CyberKnife head leakage was found to overestimate the amount of leakage radiation that is capable of penetrating more than a few centimeters of concrete. **Conclusion:** A newly proposed method of performing the secondary barrier calculation which makes use of these data is presented and shown to yield a result that is consistent with the approach in NCRP Report 151.
Conflict of Interest: This work was sponsored by Accuray, Inc.