

AbstractID: 12752 Title: A fault tree model and analyses for Gamma Knife stereotactic radiosurgery

Purpose: To develop a fault tree model of Gamma Knife stereotactic radiosurgery (GKSRS) with Model 4C to identify critical errors leading to medical events.

Methods and Materials: We constructed a fault tree with a medical event as the top event, i.e., the administered dose being different by more than 10% from the prescription dose. The fault tree consisted of 47 basic events and 30 logic gates (25 OR and 5 AND gates). The basic events were grouped into five types of errors: the hardware (15 events), software (8), human (22), and other (5) errors. The probabilities of basic events were subjectively estimated based on authors' experiences and some published data. By varying the probabilities of the five types of events, we calculated the probabilities of the medical event.

Results: For a reference case we assumed that the probabilities of occurrences of hardware, software, human, and other types of errors were 10^{-7} , 10^{-7} , 10^{-6} , and 10^{-7} , respectively. The calculation yielded 20 events per a million treatments as the probability of the medical event. When we decreased the probability of the human errors (e.g., incorrect depth measurements, a failure in identifying treatment site, etc.) to 10^{-7} , we found that the medical event occurred only 4 times per a million procedures. When the probabilities of other three types of errors were changed to 10^{-9} , the medical event probability decreased only slightly to 18 per million.

Conclusions: Our initial analysis showed that decreasing the human errors before and during GKSRS is the most effective among potential errors for decreasing the medical event. Most of the human errors can be prevented by performing secondary checks of the treatment parameters and setups. The model is being applied to evaluate the usefulness of patient-specific secondary dose calculation software for prevention of hazardous errors in GKSRS procedures.