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Use an Electrometer's Time-Series Data Logger Function in SRS QA in Timer Error and Timer Linearity

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Abstract
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Abstract

Objectives:

This study applies the time-series data logger function of an electrometer in Gamma Knife (GK) ICON QA. The manual method to use the PTW Semiflex chamber to measure the dose rate, timer accuracy, timer linearity, timer error, and transit dose has at least three issues: 1) it is strictly inaccurate because the chamber volume is too large for the 4mm collimator by which the source sectors must pass twice for each 16 mm collimator on-off action; 2) its integrated dose method is not accurate enough to measure the low tenth of a sec time error for the 4 mm and 8 mm collimator; 3) it is time consuming and random error prone. All can be overcome by the post processed differential data collected using the time-series data function.

Methods:

A PTW chamber, inside a 16 cm diameter sphere solid water phantom, was positioned at the focal point (isocenter) of a GK. The chamber was connected to an electrometer of time-series data logger function with its sampling rate at 0.5 sec. Only 16 mm collimator is measured in the monthly QA. The current as the differential data was logged for four shots of 0.5, 1, 5, and 10 min. A collimator size correction factor was applied to all 4 mm collimator data. The charge is the integration of the current over time. The dose rate, timer accuracy, timer linearity, timer error, and transit dose can be obtained from the dose- shot time linear fitting. In annual QA, a small volume diamond detector replaced the chamber. The timer errors for all three collimators can be fitted using sigmoid function from the differential current-time data.

Results:

For monthly QA, the dose rate, timer accuracy, timer linearity, timer error, and transit dose are 3.13 Gy/min, 59.5 sec, 1.00, 0.02 sec, and 0.001 Gy, respectively. For annual QA, the timer errors for 4mm, 8mm, and 16mm collimators are 0.26, 0.16, and 0.48 sec, respectively. The data collection time is the unavoidable exposure time, and the data processing time is less than 1 min on an i7 pc

Conclusion(s):

This study demonstrated that a time-series data logger function can be used to perform tasks accurately and efficiently in GK's monthly and annual QA.