AbstractID: 5054 Title: A Modified TG-51 Formalism for Gamma Knife Dose Rate Calibration

Purpose: The first Lekshell Gamma Knife was developed in 1968. Currently there is no national standard calibration protocol developed specifically for gamma knife dose calibration. Many gamma knife centers perform calibration using TG-21 protocol, while other centers use TG-51 calibration factor $N_{D,W}$. The purpose of this study is: to exam TG-21 and TG-51 calibration formalism; to compare result of gamma knife dose calibration using these two methods; and to determine if a simplified formula can be applied to gamma knife dose rate calibration.

Method and Materials: Exradin A16 ion chamber (wall material C552) was placed in a 16cm spherical polystyrene phantom in our Lekshell Gamma Knife 4C. Dose rate can be calculated using Ngas or $N_{D,W}$:

TG-21 $D_{Water}/M = Ngas \times (L/\rho)^{med}_{air} \times P_{wall} \times P_{repl} \times (\mu/\rho)^{med}_{water}$

"Modified TG-51" $D_{Water}/M = N_{D,W} \times k$

where M is corrected charge reading; k an unknown correction for polystyrene phantom.
Left hand side of the equations is dose rate to water per unit charge. For a given chamber, the factors on the right side of equations are all known except k, which can be determined by comparing above equations.

Results: For our A16 chamber:

$N_{D,W} / Ngas = 1.101$

$(L/\rho)^{med}_{air} \times P_{wall} \times P_{repl} \times (\mu/\rho)^{med}_{water} = 1.122$

Even if we ignore the unknown correction factor k, the difference between TG-21 and TG-51 calculated dose rate is 1.9%. Thus we estimated k to be in the order of 2% for this A16 ion chamber.

Conclusion: A "modified TG-51" formula, $D_{Water} = M \times N_{D,W} \times k$, can be used to calibrate gamma knife dose rate. Correction factor k can be determined from the values of $N_{D,W}$, Ngas, and other known factors found in TG-21. Difference between "modified TG-51" and TG-21 calculated dose rate is expected to be less than 2%.