Improving Uncertainty in GammaPod Dose Through the Use of $N_{D,w}$ and IAEA TRS 483

ByongYong Yi, Stewart Becker

Department of Radiation Oncology, University of Maryland, School of Medicine, Baltimore

UNIVERSITY of MARYLAND SCHOOL OF MEDICINE

DEPARTMENT OF RADIATION ONCOLOGY

JULY 12–16 2020 VIRTUAL JOINT AAPM | COMP MEETING

EASTERN TIME [GMT-4]

INTRODUCTION

- GammPod (Xcision Medical Systems, Columbia, MD) is a Breast Streotactic Radiosurgery System which is developed recently,
- The planning system requires dose calibration against PMMA phantom,
- No recent dosimetric Protocol offers small FS dosimetry in a non-water phantom,
- A method using TG-21 and IAEA TRS 483 has been recently published, but very complex, prone to error,
- This study proposes to combine IAEA TRS 483 with a new measurement & Monte Carlo based k_Q value and $N_{D,w}$ to make the procedure simpler to reduce these uncertainties.

DERIVATION OF DOSIMETRIC EQUATIONS

Dose to PMMA in the machine specific reference (msr) field is given as

$$D^{f_{msr}}_{PMMA,Q_{msr}} = M^{f_{msr}}_{PMMA,Q_{msr}} N^{f_{msr}}_{D,PMMA,Q_{msr}}, \quad (1)$$

Since, a chamber calibration factor at PMMA, msr may be obtained,

$$N^{f_{msr}}_{D,PMMA,Q_{msr}} = N^{f_{ref}}_{D,w,Q_0} k^{f_{msr},f_{ref}}_{PMMA,Q_{msr},w,Q_{ref}}, \quad (2)$$

$N^{f_{ref}}_{D,w,Q_0}$ is a chamber calibration factor from a standard lab and fields;

$$k^{f_{msr},f_{ref}}_{PMMA,Q_{msr},w,Q_{ref}} = \frac{N^{f_{msr}}_{D,PMMA,Q_{msr}}}{N^{f_{ref}}_{D,w,Q_0}},$$

$$= \frac{D^{f_{msr}}_{PMMA,Q_{msr}}/M^{f_{msr}}_{PMMA,Q_{msr}}}{D^{f_{ref}}_{w,Q_0}/M^{f_{ref}}_{w,Q_0}},$$

$$= \frac{D^{f_{msr}}_{PMMA,Q_{msr}}/M^{f_{msr}}_{PMMA,Q_{msr}}}{D^{f_{msr}}_{w,Q_{msr}}/M^{f_{msr}}_{w,Q_{msr}}} \times \frac{D^{f_{msr}}_{w,Q_{msr}}/M^{f_{msr}}_{w,Q_{msr}}}{D^{f_{ref}}_{w,Q_0}/M^{f_{ref}}_{w,Q_0}}, \quad (3)$$

RESULTS

First term of Eq 3 for is determined to be 0.974 for Exradin A1SL chamber from measurements and Monte Carlo Calculations.
Second term of Eq 3 is determined to be 1 for the chamber from the Gamma Knife data of the Table 14 of TRS 483.

Table 1. Source of Uncertainties between TG21/TRS483 based method and this study.

	From Nx to Ngas	Small field conversion	Monte Carlo for k_Q	Overall
TG21/TRS483 (Ref 8)	1.1%	1%	1.6%	2.2%
This Study	N/A	N/A	1.6%	1.6%

REFERENCE

1. Becker SJ, Culberson WS, Poirier Y, et al. Dosimetry evaluation of the GammaPod stereotactic radiosurgery device based on established AAPM and IAEA protocols [published online ahead of print 2020/04/24]. *Med Phys.* 2020.

CONCLUSIONS

We successfully implemented the TRS 483 reference dosimetry protocols utilizing ND,w for the GammaPod in the PMMA phantom.