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CALA Poster Competition

Commissioning of Radiosurgery Conical Collimators Using TRS 483

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CEMENER DIAGNÓSTICO Y TRATAMIENTO

Introduction –

Radiosurgery is a complex radiotherapy technique which requires high levels of precision due to the high dose delivered in few fractions over a small volume surrounded by risk structures. In order to protect these structures and generate a high dose gradient, the technique can be administered using conical collimators, which form fields considered small. Working with these fields implies dosimetric difficulties and challenges, for which new protocols such as IAEA AAPM TRS 483 [1] have been developed

Objective –

To commission the radiosurgery technique with conical collimators at Fundacion CEMENER, using the latest recomendations in the small fields subject and making use of the wide range of dosimetry tools present in the institution.

Materials and methods –

The Varian ICVI radiosurgery system was commissioned, using 4mm, 5mm, 7.5mm, 10mm, 12.5mm, 15mm and 17.5mm conical collimators (Fig. 1). 6MV and 10MV nominal potential photon beams with and without a flattening filter were used in a TrueBeam STx accelerator.

Dose profiles, TMRs and Output Factors (OF) were measured, following the new recommendations [1] [2]. The measurement of profiles and TMR was permformed using the Edge small field detector (Fig. 2), as well as the automatic 3D Scanner phantom (Fig. 3) together with its 3D TPR accessory (Fig. 4)

In the case of OF, redundancy was gained using, in addition, microDiamond and E Diode detectors. The centering was performed from the cross and in profiles. he OF were determined as a dose ratio between the clinical field of interest and a reference field and following technical document 483. It applies the correction factor $k_{Qclin,Qmsr}$, dependent on the FWHM and the detector type, which relates the quality and other energy aspects of both fields and allows the quotient to be performed.

Measurements were compared with Varian representative data.

Fig. 1: *ICVI system conical collimators.*

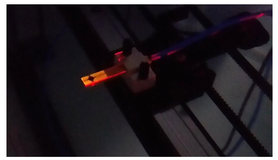

Fig. 2: *Edge small field detector.*

Fig. 3: *Automatic 3D Scanner phantom.*

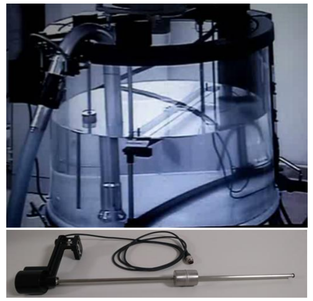

Fig. 4: *3D TPR accessory used to measure TMR mounted on the 3D Scanner.*

Results and Discussion –

Direct measurement of TMR has technical advantages over PDD in small fields, both due to problems associated with the measurement and the conversion to TPR in this type of field. The comparison of TMR measured with those provided by the manufacturer showed good agreement in all the cones (Fig. 5). In the same way, the profiles presented good concordance regarding the penumbra (Fig. 6) and slight differences were found in the field size, all within the machining tolerance of the cone construction.

On the contrary, the OF measurements of the three detectors coincided with each other, showing differences of up to 10% with those provided by the manufacturer (Fig. 7), therefore, it is believed that they do not apply the new formulism, in particular the correction factor $k_{Qclin,Qmsr}$. This observation was presented to the manufacturer for analysis and was subsequently confirmed.

After generating the calculation model, calculated curves were compared with measurements and their agreement was analyzed (Fig. 8 and Fig. 9). In the particular case of the profiles, a gamma analysis was performed with a 1% 0.5mm criterion and it was approved in 100% of the points.

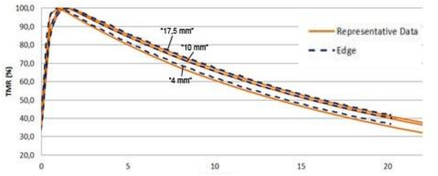

Fig. 5: *Comparison between measured 6 MV TMRs and those provided in representative data for 4mm, 10mm and 17.5mm cones.*

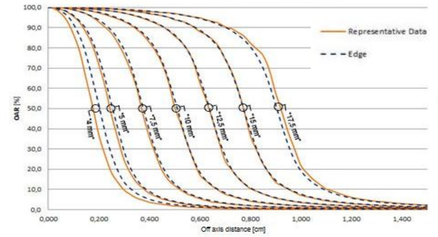

Fig. 6: *Comparison between measured profiles and those provided in representative data for the 6 MV beam.*

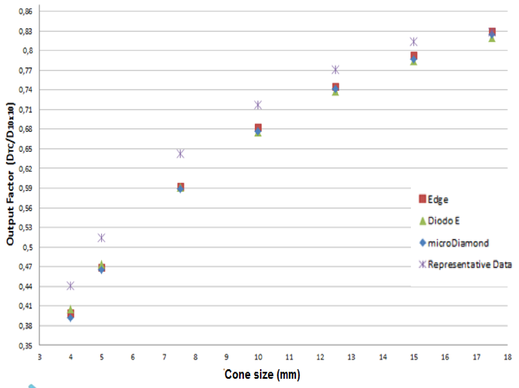

Fig. 7: *Comparison between output factors obtained with different detectors and those provided in the representative data.*

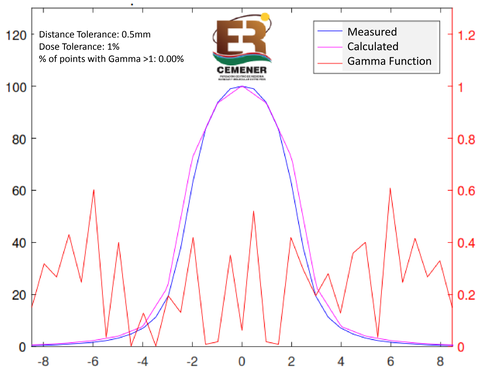

Fig. 8: *Comparison between a measured profile and another calculated in Eclipse Cone Planning for the 5mm cone.*

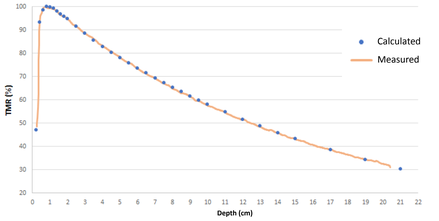

Fig. 9: *Comparison between a measured TMR and points calculated in Eclipse Cone Planning for the 4mm cone.*

Conclutions –

Implementing the radiosurgery technique is an important dosimetric challenge. Special care must be taken in the data acquisition, so the following of international guidelines on the subject is suggested.

Although the representative data that the manufacturer can provide are very useful, they should be used only for comparison and guidance, and never replace own measurements.

References –

1 - Palmans H, Andreo P, Huq MS, Seuntjens J, Christaki K. Dosimetry of Small Static Fields used in External Beam Radiotherapy: An IAEA–AAPM International Code of Practice for Reference and Relative Dose Determination. Technical Report Series No. 483. Vienna: International Atomic Energy Agency; 2017.

2 - Menzel HG, DeLuca P, et al. ICRU Report 91: prescribing, recording, and reporting of stereotactic treatments with small photon beams. J ICRU. 2017.