Acceptance and commissioning in Radiosurgery: problems and solutions

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With the recent new technologies it is becoming mandatory to establish a series of tests to be performed in order to implement a quality assurance program for Radiosurgery.

In this work, will be presented the results of the acceptance and commissioning from a linear accelerator Varian 6EX associated with a BrainLab micro-multileaf collimator system (m3) at Clinicas Hospital. The acquired experience will be emphasized on the main problems encountered during the acceptance and commissioning of this Radiosurgery system in order to provide the possible solutions to users.

According to the AAPM document [1], the recommended tests are mainly divided into acceptance and commissioning tests. For the acceptance tests, several checklists have been provided by the manufacturers (Varian and BrainLab) in order to apply the AAPM recommendations [1]. These tests include the following parameters: stereotactic target positioner; CT-X-ray localizer; diagnostic data acquisition (CT, MRI and angiography)*;* treatment planning systems (BrainScan and iPlan) – hardware and software; Winston-Lutz test among others.

During the acceptance test, by checking the transfer of CT images of a small PMMA phantom with the frame attached to the treatment planning system (iPlan), those slices were not recognized due to the lack of recognition of the fiducials since one side of the head frame was inversed. In order to fix this problem, the frame was sent to Germany for repair. After that, the results thus obtained showed good agreement with the manufacturer's specifications.

For the commissioning of dosimetric tests [2], measurements for non-reference conditions have been performed in order to verify the algorithm effectiveness (pencil beam). Measurements were performed for depth dose distributions for square fields from maximum to minimum field sizes (from 6x6 mm^2 to 100x100 m^2); scatter factors (with and without the mMLC); diagonal radial fields (mMLC unmounted and jaws retracted). The main issue was to select the proper size of the detector for some types of measurements: for instance, for field sizes smaller than 12 x 12 mm^2, a stereotactic diode was employed since the noise-to-signal of a pin point ionisation chamber (0,01 cm^3) was inadequate for such measurements. All absolute absorbed dose measurements were performed by making use of a Farmer cylindrical chamber (0.6 cm^3) which was calibrated in terms of absorbed dose to water according to IAEA TRS398 [3]. The lack of charged particle equilibrium is the main task for the dosimetry of small fields.

In order to evaluate the beam profile, a comparison of measurements made with different detectors was performed and the results are shown in Table 1.

Table 1: Analysis of beam profile for a 18x18 mm^2 field size obtained with different detectors.

	CC01 (0.01 cm^3)	**Stereotactic Diode** (1.7x10-5 cm^3)	**CC13** (0.13 cm^3)	**Radiographic Film (Kodak X-Omat)**
Simetry	4,3%	10,5%	5,8%	0,41%
Penumbra	5,0 mm	4,6 mm	6,4 mm	3,5 mm

It should be noticed the difference of the penumbra when measured by the diode in comparison with the ion chambers measurements. For the symmetry, better results were obtained by the ion chambers. However, for field sizes smaller than 12x12 mm^2, the radiographic film can be considered as the best dosimetric system due to its highest spatial measurements. It should thus be pointed out the importance of the comparison of all available dosimetric systems for the proper evaluation of the results for small field dosimetry (non-equilibrium condition).

Some practical problems occurred during the clinical implementation of Radiosurgery which are important to be described for those users who are interested in implementing this kind of technique. In order to perform dynamic arcs, the gantry's counterweight must be increased since some arcs were pending in a few directions. Another problem is the dose rate should be increased due to the fact that the maximum monitor units were higher than the time setting given by the accelerator. Some communication problems also happened between the treatment planning system (iPlan) and the record & verify system (Aria, Varian). It was due that there were different machines names at the Aria system and this problem was solved by transferring data to mMCL controller.

REFERENCES

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