Does classical 2nd monitor unit calculation still have a future? Validation of a comprehensive QA software

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OBJECTIVES

Quality control of radiotherapy treatment plans includes secondary independent calculation of monitor units. However, with the development of new technology, this single point calculation is getting less relevant and does not always permit an informed decision.
The aim of this study is to investigate the ability of a commercial software (Mobius 3D, FX, version 4.1, Mobius Medical Systems, Houston, TX) to propose an integrated solution from calculation to delivery while decreasing control time on treatment units.

METHODS

Our department uses several TPS with different algorithms (Isogray v4.2, Eclipse v10, Tomotherapy v5). Various treatment technics (Tomotherapy, VMAT, dynamic IMRT, classical 3D conformal for Clinac) are available.
Mobius V4.1 was used with golden data provided by vendors to test our beam modeling.
The algorithm used is collapsed cone convolution superposition with 144 isotropically-spaced cones, a step size always inferior to a voxel and high resolution kernels. It provides independent monitor unit calculation, 3D isodoses statistics and dosimetric benchmark.
For Varian treatments, uploading dynalog files in this software permits calculation of the difference between the calculated and delivered leaf positions and its impact on 3D dose calculation.

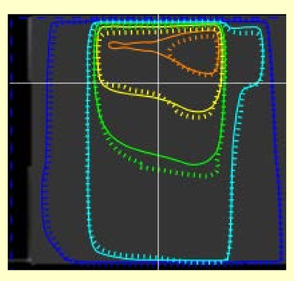

Figure 1 : comparison of Dosisoft isodoses for a wedge on an homogeneous fantom versus Mobius 3D (dashed)

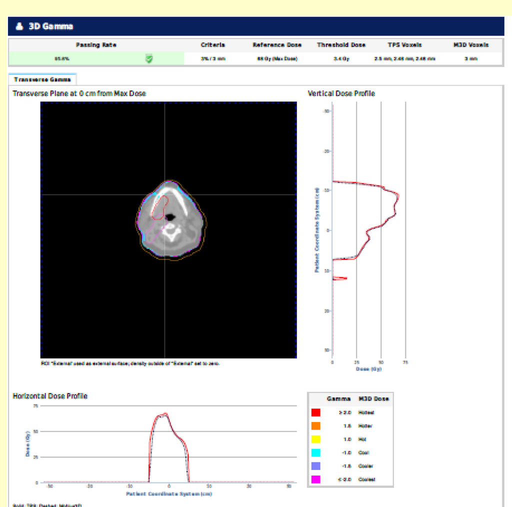

Figure 2 : Comparison of gamma index for a RapidArc Head and neck case versus Mobius 3D

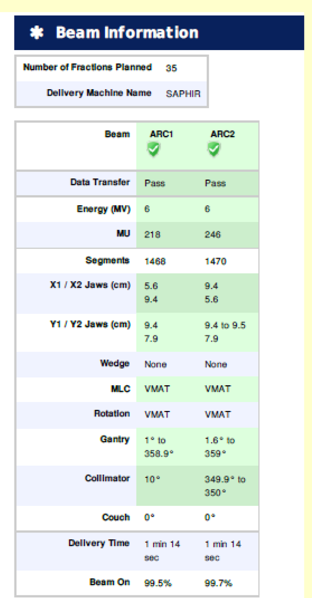

Figure 3 : Beam information for a RapidArc Head and neck case versus Mobius 3D

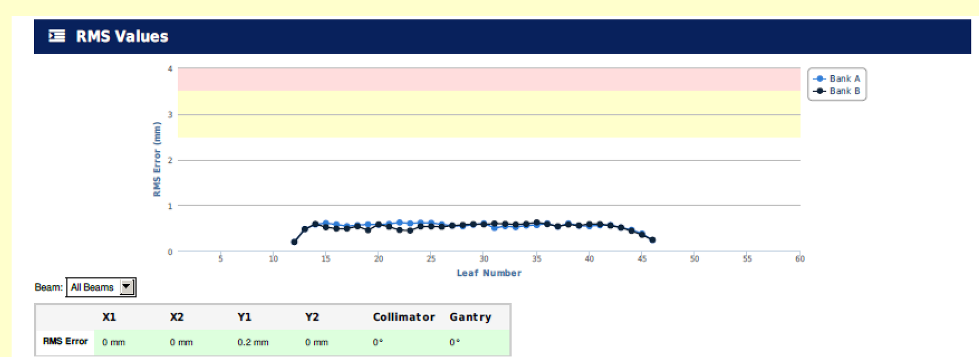

Figure 4 : root mean square analysis of leaf positonning for a Head and neck RapidArc treatment

Figure 5 : HDV comparison for an head and Neck case for Tomotherapy

RESULTS

We have validated the commercial software by increasing difficulties from unmodulated to modulated field, on a cubic homogeneous phantom (Figure 1 with a wedge) then on a round heterogeneous one. Difference between TPS and Mobius were inferior to 0.5% for UM calculation for 3D conformal treatment and up to 0.6% differences on mean doses. Gamma passing rate (3%-3mm) was up to 100%.

For rapid arc patient, differences for mean doses were between 0.9 and 2%; up to 2.3% UM difference (Figure 2 and 3). Gamma passing rate was 99.7% for (3%-3mm). Dynalog files were uploaded after treatment session and Mobius FX highlights a difference of 0,2mm (RMS error) between planned and delivered position of bank Y2 leafs (Figure 4).

For Tomotherapy treatment, calculated dose distribution shows mean gamma passing rate of 99.6%+/-1.15% (Figure 5).

CONCLUSIONS

To have a multi-brand environment complicates the legal independent monitor unit calculation; a complete solution in one software accessible from every institutional PC facilitates the workflow.
Tools as risk of collision, templates of dosimetric alert thresholds positions the software in a global context of quality treatment plans preparation, planning, treatment (taking into account the actual position of the leafs). As far as we know, this is the only software doing a second calculation of dose distribution for Tomotherapy.

Is this change in the quality evaluation of treatment plans another step towards safety? Preliminary results show this solution permits to analyze every step of the process in an efficient way. The web based solution is flexible, easy to use.
Next step will be to analyze the possibility to replace the treatment plans measurements by automatic analysis post treatment. FX plan delivery verification via DVH and 3D dose comparison using machine delivery log file based dose reconstruction would permit to diminish our patient control.
This commercial DICOM-RT based plan verification system is, according to us, the future of independent calculation.

References

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