Evaluation of a new portal dosimetry solution for dose quality control of Elekta and Varian linacs

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Purpose or Objective

The aim of this study is to evaluate a new portal dosimetry solution (ARTISCAN Beam QA, AQUILAB - France) for independent QA of photon and electron beams on Elekta and Varian linacs.

Material and Methods

ARTISCAN Beam QA software is based on EpiDream method (Boutry et al, Med Phys 2017) converting EPID signal in air into absorbed dose in reference conditions. The product is developed to perform dose quality control of photon and electron beams using EPID.

Our study was performed on 6 MV and 6 MV FFF photon beams from Elekta linac (Versa HD with iViewGT v3.4.1) and on 6 MV photon beam and 6 MeV electron beam from Varian linac (Clinac 2100C with EPID AS500). Intrinsic characteristics of the solution were first evaluated, including repeatability, reproducibility, dose linearity and dose consistency over the time. Then, we performed tests of our current internal QA program: daily X-Ray and electron output constancy, beam profiles constancy, wedge transmission factor constancy, monitor chamber linearity. Results were compared to those obtained with ionization chamber (0.6 cc, PTW) or with ionization chamber 2D-matrix (StarCheck, PTW).

Results

The reproducibility of 10 EPID measurements was 0.09% for 6 MV (Elekta). Dose linearity for photon and electron beams for the Varian linac was better than 1% for MUs higher than 20 with EPID solution. From 3 to 15 MUs, dose linearity was between 1.3% and 2.4% for photon beam and 0.7% and 1.9% for electron beam EPID solution. A 4 months analysis showed a dose deviation for a square field between +0.05% and -1.25% for 6 MV beam and between +0.39% and - 1% for 6 MV FFF beam (Elekta). For the daily output constancy on Elekta linac, the mean difference obtained for 32 QAs between EPID dosimetry and ionization chamber was -0.1% (σ=0.3%) for 6 MV and -0.6% (σ=0.3%) for 6 MV FFF beam. Beam profiles obtained with ARTISCAN Beam QA software and the StarCheck were plotted for 6 MV, 6 MV FFF and 6 MeV beams in Fig 1. The difference on wedge transmission factor obtained with EPID solution and ionization chamber was 0.2% for 6 MV (Varian). The maximal difference on monitor chamber linearity for 6 MV beam (Varian) between EPID solution and ionization chamber was 1.4% for MUs higher than 3, reaching 5% for 1 MU.

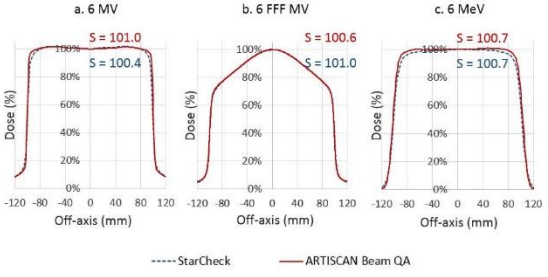

Fig 1: Inplane profiles for 6 MV (a.), 6 FFF MV (b.) photon beams and 6 MeV (c.) electron beam, obtained with the StarCheck matrix (blue dashed curves) and with ARTISCAN Beam QA (red solid curves). The symmetry S is computed as $S = 100 \times \left(\frac{D(x)}{D(-x)}\right)_{max}$, D(x) and D(-x) being the symmetric points in the 80% isodose for the photon beams and in the 90% isodose – 1 cm for the electron beam.

Conclusion

Our results showed that the EPID dosimetry solution proposed by AQUILAB seems to be promising to perform QA programs on Elekta and Varian linacs for both photon and electron beams.

Reference

A simple algorithm to convert EPID gray values into absorbed dose to water without prior knowledge. Boutry C, Sors A, Fontaine J, Delaby N, Delpon G. Med Phys. 2017 Dec; 44(12):6647-6653.