World Academy of Science, Engineering and Technology
International Journal of Biomedical and Biological Engineering
Vol:11, No:11, 2017

The Validation of RadCalc for Clinical Use: An Independent Monitor Unit Verification Software

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Abstract : In the matter of patient treatment planning quality assurance in 3D conformational therapy (3D-CRT) and volumetric arc therapy (VMAT or RapidArc), the independent monitor unit verification calculation (MUVC) is an indispensable part of the process. Concerning 3D-CRT treatment planning, the MUVC can be performed manually applying the standard ESTRO formalism. However, due to the complex shape and the amount of beams in advanced treatment planning technic such as RapidArc, the manual independent MUVC is inadequate. Therefore, commercially available software such as RadCalc can be used to perform the MUVC in complex treatment planning been. Indeed, RadCalc (version 6.3 LifeLine Inc.) uses a simplified Clarkson algorithm to compute the dose contribution for individual RapidArc fields to the isocenter. The purpose of this project is the validation of RadCalc in 3D-CRT and RapidArc for treatment planning dosimetry quality assurance at Antoine Lacassagne center (Nice, France). Firstly, the interfaces between RadCalc and our treatment planning systems (TPS) Isogray (version 4.2) and Eclipse (version13.6) were checked for data transfer accuracy. Secondly, we created test plans in both Isogray and Eclipse featuring open fields, wedges fields, and irregular MLC fields. These test plans were transferred from TPSs according to the radiotherapy protocol of DICOM RT to RadCalc and the linac via Mosaiq (version 2.5). Measurements were performed in water phantom using a PTW cylindrical semiflex ionisation chamber (0.3 cm^3, 31010) and compared with the TPSs and RadCalc calculation. Finally, 30 3D-CRT plans and 40 RapidArc plans created with patients CT scan were recalculated using the CT scan of a solid PMMA water equivalent phantom for 3D-CRT and the Octavius II phantom (PTW) CT scan for RapidArc. Next, we measure the doses delivered into these phantoms for each plan with a 0.3 cm^3 PTW 31010 cylindrical semiflex ionisation chamber (3D-CRT) and 0.015 cm^3 PTW PinPoint ionisation chamber (Rapidarc). For our test plans, good agreements were found between calculation (RadCalc and TPSs) and measurement (mean: 1.3%; standard deviation: ± 0.8%). Regarding the patient plans, the measured doses were compared to the calculation in RadCalc and in our TPSs. Moreover, RadCalc calculations were compared to Isogray and Eclispse ones. Agreements better than (2.8%; ± 1.2%) were found between RadCalc and TPSs. As for the comparison between calculation and measurement the agreement for all of our plans was better than (2.3%; ± 1.1%). The independent MU verification calculation software RadCal has been validated for clinical use and for both 3D-CRT and RapidArc techniques. The perspective of this project includes the validation of RadCal for the Tomotherapy machine installed at centre Antoine Lacassagne.

Keywords : 3D conformational radiotherapy, intensity modulated radiotherapy, monitor unit calculation, dosimetry quality assurance
Conference Title : ICBMP 2017 : International Conference on Biophysics and Medical Physics
Conference Location : Cape Town, South Africa
Conference Dates : November 02-03, 2017