Abstract

From the acceptance tests to the clinical implementation of a Radixact unit at Candiolo Cancer Institute - IRRCS

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Purpose: The scope of this thesis is to provide a comprehensive overview of the commissioning, acceptance, and clinical implementation of a new Radixact unit at the Candiolo Cancer Institute - IRCCS.

Methods and materials: Thirty specific examination, divided in seven groups, are executed in order to confirm the dosimetric, geometrical and mechanical designation of the device. The inspections are carried out by employing both ionization chambers, films, and solid state detectors. Also, two distinguished TPS are implemented in the center through the execution of dosimetric validations and patient's specific Quality Assessments (QA). For the latter purpose, a cohort of thirty-one patients are tested using two different detector types: a semiconductor diode array and ionization chambers. Hence the results are investigated through the gamma index and dose difference analysis. Importantly, it is implemented a workflow for the interchangeability of TPS and delivery units, which optimizes the patients' scheduling and provides a solution when the device cannot deliver a treatment fraction. Its clinical validation is performed by way of seventeen patient's specific QAs of diverse treatment requests. A total of 113 acquisitions of patients' punctual or extended radiation dose are performed to clinically validate the device. At the end, two techniques which exploit the Radixact integrated kVCT imaging system, and a deformable registration algorithm are introduced for the implementation of adaptive radiotherapy in the center.

Results: All the inspections carried out for the commissioning process of the device furnish results aligned with the requests in the Report of the AAPM Task Group 148 and Task Group 306. Also, all the gamma index analysis (performed with DD=3%, DTA=2mm, threshold=10%, Global) in the patients' QAs give a passing rate greater than 95%. So the results are within the universal tolerance limit of 95% as proposed in the recommendation of the AAPM Task Group 218. The mean values and standard deviation of patients' specific QAs gamma passing rate for the two implemented TPS are 98.9±1.6 and 99.4±1.1.

Conclusion: This thesis affirms the full clinical implementation of the Radixact device at the Candiolo Cancer Institute - IRCCS, marking a significant milestone in improving patient care and treatment delivery in the hospital.

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